# OCTOBER, 1918 No. 4

Monthly Review of Surgical Science and Practice LEWIS STEPHEN PILCHER, MD, LLD

SIR WILLIAM MACEWEN, MD. LLD With the Collaboration of

THE TREATMENT OF TUMORS OF THE SUPERIOR MAXILLA SIR W WATSON CHEYNE, CB. FRS

THE OPERATIVE TREATMENT OF TRIFACIAL NEURALGIA A NOTE ON THE SURGICAL TREATMENT OF CERTAIN DISEASES BY NEW YORK

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SURGICAL ASPECTS OF RIGHT SUBPHRENIC ABSCESS

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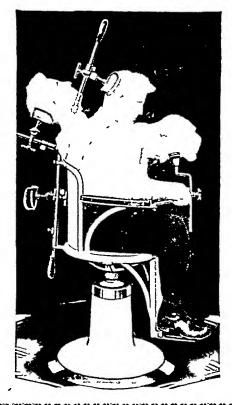
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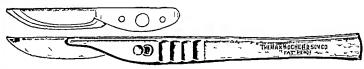
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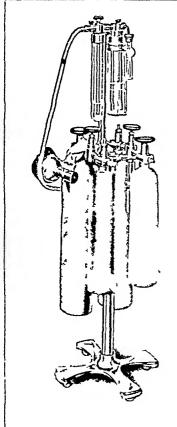
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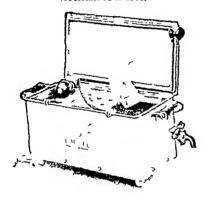
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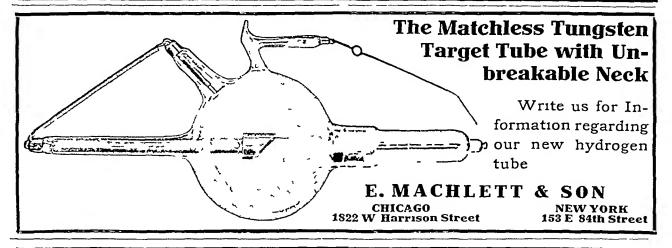
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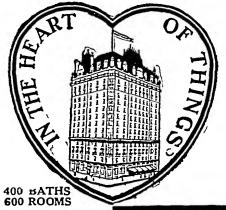
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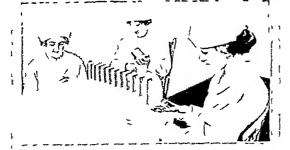
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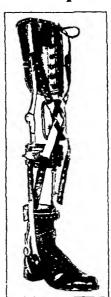
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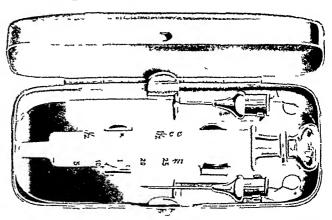
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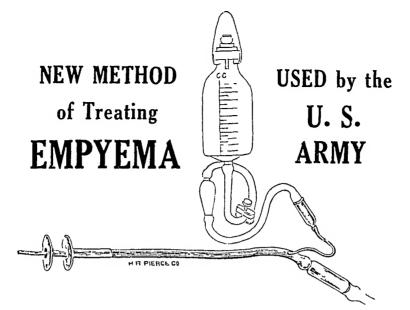
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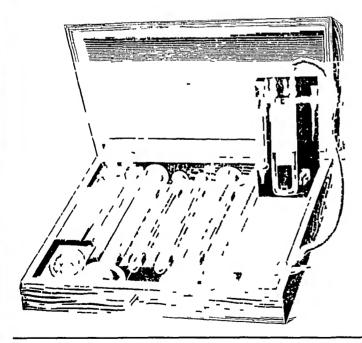


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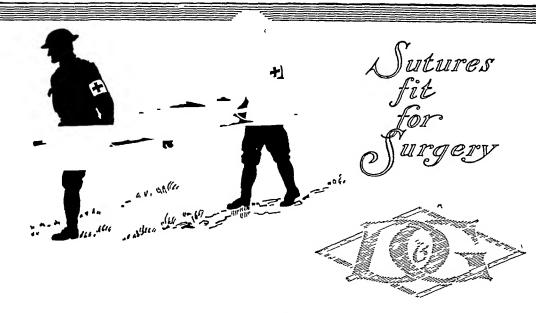
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### ANNALS of SURGERY

Vol. LXVIII

JULY, 1918

No 1

#### THE USE OF FASCIAL TRANSPLANTS IN WAR SURGERY

By L C BALLEUIL, M D

OF THE FRENCH ARMY

Bungron-in chief to the hôpital des Jacobins and chef du centre physiotherapie a troyes

AND

#### W D JACK, M D

IST LIEUTENANT M O R C, DIVISION OF UROLOGY, AMERICAN EXPEDITIONARY FORCE

Owing to the fact that such a high percentage of wounds of war are infected, require drainage for long periods of time and heal by granulation, extensive fibrous tissue formation often occurs and leads not only to unsightly scars but oftentimes also to marked deformity and disability. Such cases have been frequently observed. They are for the most part old wounds of the arm or leg in which either muscles, tendons or nerves have been caught in the cicatrix—or in which muscle hermas have occurred because of the loss of either muscle tissue or its fascial envelope. We may point out that these cases are beyond the scope of physiotherapy as it is ordinarily applied, and one finds that most of them are neglected surgically. We wish, therefore, to call attention to a plastic method of repairing these deformities by utilizing fascial transplants—and to report a series of cases in which it has been employed with complete success

The type of case selected for aponeurotic grafts has been variable. Extensive scars of the forearm or leg involving either the flexor or extensor tendons and thus producing disability have been the most common. Muscle hernias have also been repaired in this way while we have applied aponeurotic grafts to the dura and in one case we have utilized the method in repairing a hernia of the synovial membrane of the knee-joint. We believe the method is applicable to the whole field of plastic surgery and there is no doubt but that the cases reported here demonstrate, beyond all question, its great value in rebuilding muscle sheaths and in repairing muscle hernias

The operative technic is simple and easy. We have at all times taken great pains to observe the fundamental surgical principles of antisepsis and hæmostasis—and in our experience comprising fifty cases the grafts have taken and the operative wounds have healed per priman without infection

The operation consists of four steps, all clearly shown in the accompanying illustrations

#### BILLUH AND JACK

- 1. The resection of the scar
- 2. The liberation of the min ch's and the margins of its aponeurosis
- 3 The cutting of the graft, its application and fixation
- 4 The reconstruction of the subcut meous tissues and skin

The scar is completely and cleanly excised and the dissection is carried down to sound and healthy muscle tissue. The muscle is then freed by cutting any adhesions binding it to its fascin—the edges of the fascin are freshered by excision, bleeding points are tied—and the freed muscle and aponeurosis are ready for the graft.

A linear incision 28-39 cm in length is then made along the outer aspect of the thigh and carried down through the subcutaneous tissues to the fascia By undermining the subcutaneous tissues good exposure of the aponeurosis can be obtained. A graft of suitable size is cut and placed in a sponge soiked with warm saline. Before applying the graft we have made it a practice to close the fascia lata with mattress sutures of catgut Ordinarily this closure is easy, but in instances where large grafts are taken it may be difficult. By first plicing all of the mattress sutures and then tightening them en masse before tying, approximation of the fascia is made easy. The skin of the thigh is then closed with interrupted sutures of silkworm gut. We are now ready to apply the graft. It is fitted to the fascial breach and fixed to either end and to either side of the breach in its centre by four sutures of oo catgut These four cardinal points immobilize the graft in exact position and it can then be readily sutured, using a continuous No oo catgut stitch. The subcutaneous tissues are then approximated by interrupted sutures of fine catgut and the skin is closed with silk or silkworm gut The limb is then immobilized in plaster and not disturbed for at least ten days

We have records of 50 cases from which we have selected typical instances to report here. The simplicity of the procedure and the fact that such excellent results have been obtained are, we believe, sufficient reasons, for urging its use

#### I REPAIR OF PAINFUL ADHERENT SCARS

Case I—Naudin A J, 26th Inf No 1308 Patient came under observation eleven months after he received a through-and-through wound of the right foreaim, which had fractured both bones. The fracture had united firmly and the bones were in good position, but two fairly large scars—one on the anterior and one on the posterior surface of the forearm—were the constant source of pain and inconvenience Electrical treatment did not improve his symptoms. Accordingly operation was carried out—and the breach in the fascia under either cicatrix was replaced by a graft of fascia lata after the scars had been excised Convalescence was uneventful and patient left the hospital some weeks later with his symptoms completely relieved (Figs 7–10).

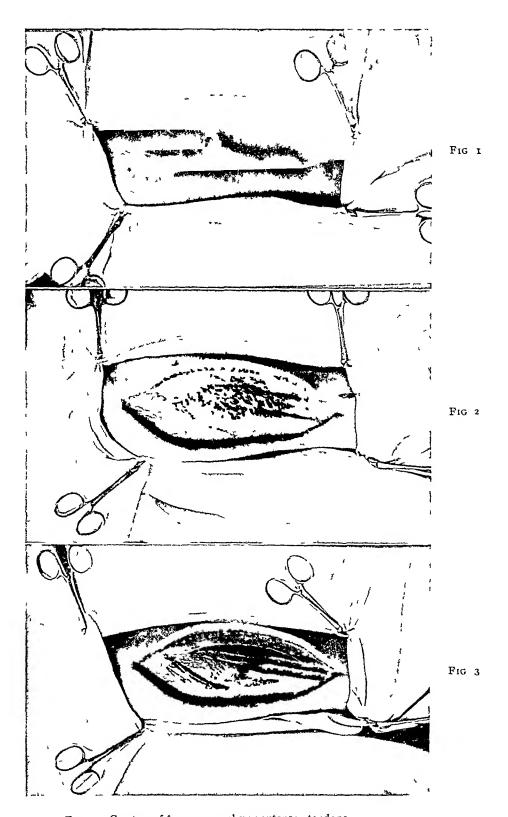


Fig 1—Cicatrix of forearm involving extensor tendons
Fig 2—Excision of cicatrix Muscle and fascia involved in scar
Fig 3—Liberation of muscle and fascia Adhesions cut away

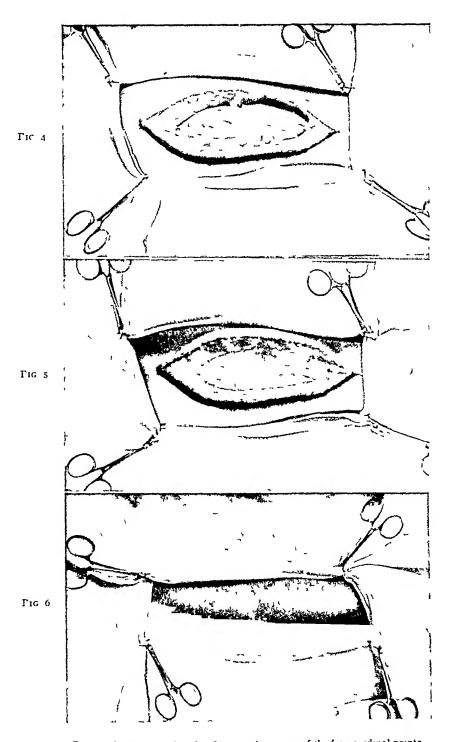
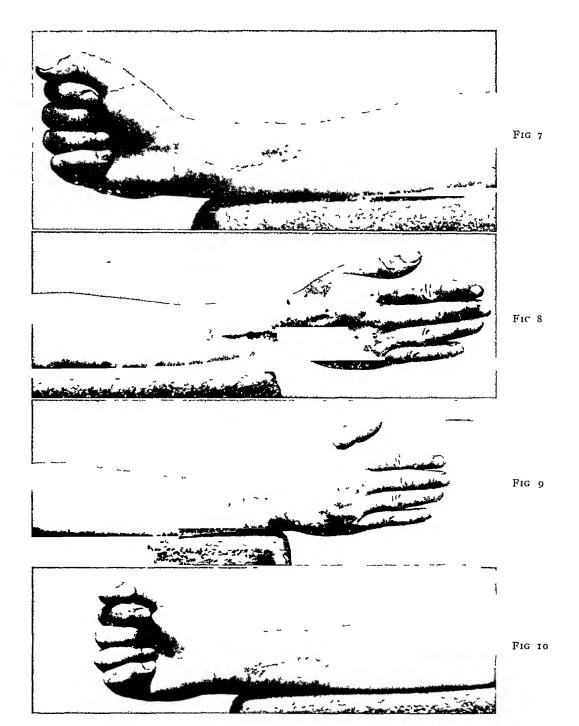


Fig. 4—Application of graft — Lixition by means of the four cardinal points  $\Gamma_{1G}$  5—Suture of graft  $\Gamma_{1C}$  6—Closure of subcutaneous tissues and skin

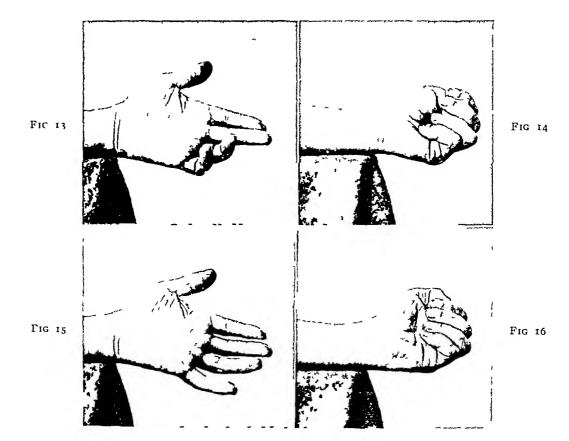


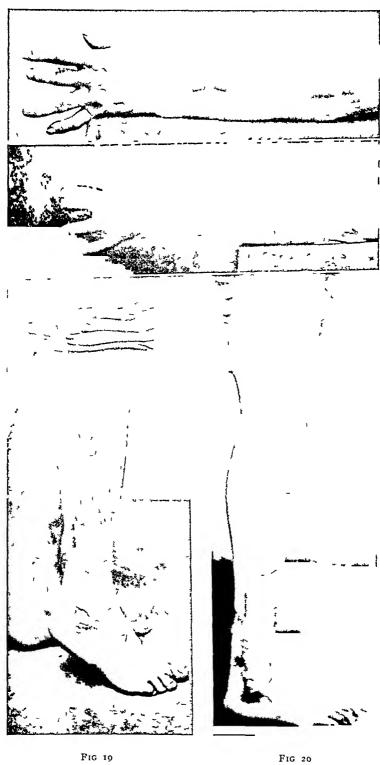






Γ1C 12





Γ1G 17

Fig 18

#### USE OF FASCIAL TRANSPLANTS IN WAR SURGERY

### II THE REPAIR OF ADIIERENT SCARS ASSOCIATED WITH MUSCULAR DISABILITY

Case I —Sergt M Paul 31st Inf No 8412 Patient was admitted to the hospital with a large scar on the anterior surface of his left leg. The cicatrix was painful and there was definite limitation of movement of the ankle and foot. He had been wounded by a shrapnel ball fifteen months previously. The wound had suppurated over a long period of time and had healed by granulation. Examination established the fact that the muscles of the leg were caught in the scar. Operation was carried out, the scar excised, and an aponeurotic graft utilized to reconstruct the destroyed muscle sheaths. Convalescence was uneventful. The wound healed per primam. The patient was discharged to service on the thirtieth day after the operation completely well. The accompanying photographs show this patient before and after operation (Figs. 11 and 12).

CASE II — C Eugène 31st Inf No 2510 Patient presented himself with a large cicatrix involving the flexor tendons of the fingers of the left hand He had been wounded four months previously seemed certain that the ulnar nerve was involved Electrical treatment was employed for four months without result operation was carried out and the scar of the forearm resected flexors of the fourth and fifth fingers were tightly bound in the cica-The median nerve was intact The ulnar nerve, however, was also caught in the scar and tied down by adhesions The tendons were freed by dissection, the nerve was also liberated and the aponeurotic planes were prepared for the graft of fascia lata which was then cut and applied There was no reaction to the operation and one month later there was definite functional improvement. The patient was treated electrically for three months, at the end of which time he was discharged cured (Figs 13-16)

Case III—D Phillipe 31st Inf No 5183 Patient presented himself with wounds of the anterior and posterior surfaces of the lower third of the left forearm. He had been wounded eleven months previously. There was an adherent scar involving the flexors and the middle finger was fixed in a position of semiflexion. The scars were resected and grafts applied to both the anterior and posterior surfaces of the forearm. The wounds healed per primam and the patient was returned to his depot a few months later with a functionally useful hand and fingers (Figs. 17 and 18)

#### THE REPAIR OF MUSCLE HERNIAS

Case I — L Aimand Emile 156th Inf No 1510 The patient came under observation with two adherent scars on the posterior surface of the right leg. There was rather marked muscular atrophy and a very pronounced equinus. There was present an obvious muscle hernia. The patient had been wounded one year before admission. Operation was carried out. The adherent scar on the external surface

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of the leg was resected There was a loss of fascia and a large muscle hernia These were repaired by means of the usual aponeurotic graft At the same time the tendon of Achilles was lengthened by the usual method The postoperative course was uneventful and the patient left the hospital on the sixtieth day very greatly improved (Figs 19 and 20)

#### CONCLUSIONS

These grafts have been employed now on more than 50 cases and we believe that we have demonstrated their value in repairing painful scars, in restoring the muscle function lost because of adherent scars, and in repairing muscle hernias. We believe further that these grafts are almost universally applicable to the field of plastic-surgery

Note —We wish to express our gratitude to Major H H Young, Director of Urology, A E F, whose kindness has made possible the publication of this paper

### VENTRICULOGRAPHY FOLLOWING THE INJECTION OF AIR INTO THE CEREBRAL VENTRICLES

#### BY WALTER E DANDY, M D

OF BALTIMORE, MD

(From the Department of Surgery, the Johns Hopkins Hospital and University)

THE value of rontgenography in the diagnosis and localization of intracranial tumors is mainly restricted to the cases in which the neoplasm has affected the skull. In an analysis of the X-ray findings in one hundred cases of brain tumor from Doctor Halsted's Clinic, Heuer and I have shown that in only 6 per cent of the cases did the tumor cast a shadow, and in these it was only the calcified areas that were differentiated by the X-rays from the normal cerebral tissues

In those instances (9 per cent of our cases) in which a tumor has encroached upon the sphenoid, ethnoid or frontal sinus, the invading portion casts a shadow in the rontgenogram. Such shadows are due to the displacement of the normally contained air by tissues which are less pervious to the X-ray. This group of shadows is of minor practical importance because the growth can be recognized by the destruction of the walls or bony septa of the sinuses.

Since the X-rays penetrate normal brain tissues, blood, cerebrospinal fluid and non-calcified tumor tissue almost equally, any changes in the brain produced by altered proportions of these components will not materially alter the rontgenogram

Although skull changes are shown by the X-ray in 45 per cent of our cases and are frequently pathognomonic, on the whole they represent late stages of the disease. As intracranial tumors come to be diagnosed and localized earlier, the value of the X-ray will be correspondingly diminished

For some time I have considered the possibility of filling the cerebral ventricles with a medium that will produce a shadow in the radiogram. If this could be done, an accurate outline of the cerebral ventricles could be photographed with X-rays, and since most neoplasms either directly or indirectly modify the size or shape of the ventricles, we should then possess an early and accurate aid to the localization of intracranial affections. In addition to its radiographic properties, any substance injected into the ventricles must satisfy two very rigid exactions (1) It must be absolutely non-irritating and non-toxic, and (2) it must be readily absorbed and excreted

The various solutions and suspensions used in pyelography—thorium,

<sup>&</sup>lt;sup>1</sup>Rontgenography in the Localization of Brain Tumor, Based Upon a Series of One Hundred Consecutive Cases The Johns Hopkins Hosp Bull, 1916, xxvii, 311 Also A Report of Seventy Cases of Brain Tumor The Johns Hopkins Hosp Bull, 1916, xxvii, 224

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potassium, iodide, collargol, argyrol, bismuth subnitrate and subcarbonate, all in various concentrations—were injected into the ventricles of dogs, but always with fatal results, owing to the injurious effects on the brain. Marked ædema, serosanguineous exudate, and petechial hemorrhages resulted. The severe reactions that are sometimes encountered after the intraspinous injection of most therapeutic remedies indicate the dangers even from carefully prepared solutions. A slight acidity or alkalimity may result even in death. It seems unlikely that any solution of radiographic value will be found which is sufficiently harmless to justify its injection into the central nervous system. Suspensions are precluded because they are not absorbed.

Ventriculography, therefore, seems possible only by the substitution of gas It is largely due to the frequent comment by Doctor for cerebrospinal fluid Halsted on the remarkable power of intestinal gases "to perforate bone" that my attention was drawn to its practical possibilities in the brain ing gas shadows are present in all abdominal and thoracic radiograms stomach and intestines are often outlined by the contained air, even more sharply than when filled with bismuth A small collection of gas in the intestines often obliterates the kidney outlines A perforation of the intestines may be diagnosed by the shadow of the air that has accumulated under the diaphragm Gas gangrene may be diagnosed by the air blebs (of B welchii) Pneumothorax is sharply outlined because the normal lung in the tissues tissues are eliminated The paranasal sinuses and mastoid air cells show up in a thick skull by virtue of the air, and pathological conditions of the sinuses are evident because inflammatory or tumor tissue replaces the air these and many other normal and pathological clinical demonstrations of the radiographic properties of air it is but a step to the injection of gas into the cerebral ventricles—pneumoventriculography

Methods—Several gases are mert and readily absorbable, and in these respects satisfy the requirements for injection into the cerebrospinal system Although it is possible other gases give even better results, we have used only air in the injections here described. The merits of other gases are now being studied

In order to obtain a skiagram of the lateral cerebral ventricles filled with air, it is necessary to remove at least more cerebrospinal fluid than the contents of one ventricle and to replace this fluid with an equal quantity of air Before closure of the fontanelles, one can readily make a ventricular puncture through the interosseus defect. After union of the sutures, it is necessary to make a small opening in the bone

Air and water in a ventricle behave exactly as they would in a closed flask Following any change in position the fluid gravitates to the most dependent part and the air rises to the top. Owing to the free communication between the third, the right and the left lateral ventricles through the foramina of Monro, fluid and air will readily pass from one ventricle to the other. Because of the curves in the ventricular system, however, it is obvious that in any given position, only part of the ventricular fluid can gravitate to the point

#### VENTRICULOGRAPHY

of the needle, so that this amount only can be aspirated 
If desired, fluid can be removed from the remaining recesses by tilting the head, just as one manipulates a curved tube to replace the fluid with air Theoretically, it should be possible to remove nearly all the ventricular fluid by suitable manipulations of the head, but for practical purposes enough fluid can be obtained from one correct position Visualization of the ventricular system will best indicate the most appropriate location for ventricular puncture and the proper position of the head It will then be seen that the most fluid can be obtained from a puncture in the anterior part of either lateral ventricle (Fig 2) The head should be placed with the face down and partially rotated so that the ventricle to be aspirated is beneath and the needle enters at the most dependent point possible. This position permits the maximal drainage of fluid from the opposite lateral and the third ventricles Aspiration through a puncture in the posterior or descending horn permits a fairly complete removal of the fluid from one ventricle and from that portion of the other lateral ventricle which is anterior to the foramen of Monro In the aspiration of fluid from the posterior horn of the lateral ventricle, the patient must he with the face directed upward and backward and the head rotated from 30 to 40 degrees toward the side of the needle

The exchange of air for cerebrospinal fluid must be made accurately. If the air injected is greater in volume than the fluid withdrawn, acute pressure symptoms will result. To attain accuracy we have used a Record syringe with a two-way valve attachment (Fig. 1). A small amount of fluid (20 c c) is aspirated and an equal quantity of air injected. This is repeated until all the fluid has been removed. By aspirating and injecting in small quantities, injury to the brain from negative pressure is prevented. Not knowing the size of the ventricles beforehand, we have no way of estimating the amount of air necessary to fill one ventricle. For this reason we have preferred the removal of all the fluid that can be readily obtained. This has been found to be but little greater than the contents of one ventricle.

Needless to say, owing to the lighter weight of air, the ventriculogram represents the ventricle farthest from the X-ray plate. To insure the best results the sagittal plane of the head should be parallel with the plate. Valuable assistance can also be obtained from anteroposterior X-rays. The head should then be placed so that the sagittal plane is vertical, preferably with the occiput resting on the plate. With the latter precaution a more even distribution of air on the two sides is obtained and the ventriculogram represents the anterior portions of both lateral ventricles. For special points in diagnosis additional anteroposterior views may be taken of the posterior and descending horns of the ventricle by placing the forehead on the plate.

Results Following Injection —We have injected air into the cerebral ventricles at least twenty times. In some instances the injection has been repeated. The amount of air injected has varied from 40 to 300 c c, the larger quantities in cases of internal hydrocephalus. Only once has there been any reaction, and in this case the injection (300 c c) was made forty-eight hours

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after the first stage of an operation for cerebellar tumor (Fig 3) The reaction was characterized by a rise of temperature, nausea, vomiting, and increased headache, all of which were quickly relieved after release of the air by a ventricular puncture. Ten days later, a large cerebellar tumor was removed, the patient making an uneventful recovery. All of the injections have been made in children varying from six months to twelve years of age. Invariably the lateral ventricle has been sharply outlined in the radiogram. In two instances the third ventricle and the foramen of Monro were visible.

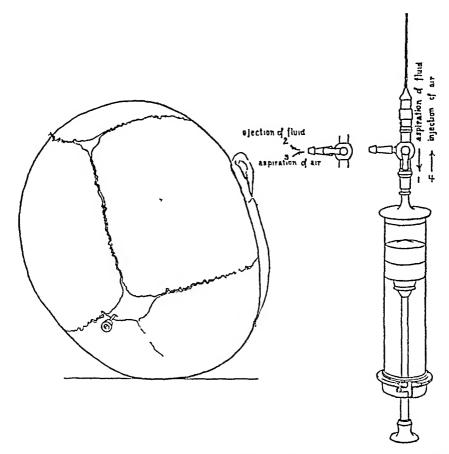


Fig 1 —Showing oblique position of head for aspiration of fluid and injection of air. The forehead is resting on plate. Note point of entrance of the needle into anterior fontanelle on dependent side. Figure on right shows record syringe and two way valve attachment used for this purpose.

(Figs 3 and 8) In none, however, have we observed the fourth ventricle or the aqueduct of Sylvius The practical value from pneumoventriculography is expected principally from the shadows of the lateral ventricles

Day by day the air shadow diminishes and eventually disappears. In a case of internal hydrocephalus it required two weeks. Possibly in more normal cases the time may be less, as air in other body tissues vanishes much more rapidly. In all probability absorption of air injected into the ventricles takes place by the same channels as in the case of the ventricular cerebrospinal

#### VENTRICULOGRAPHY

fluid In a previous communication <sup>2</sup> it has been shown that cerebrospinal fluid is almost entirely absorbed from the subarachnoid space, that only a very slight absorption takes place from the ventricles Phenolsulphonephthalein in a closed ventricular system disappears in from ten to twelve days, whereas it is absorbed in from ten to twelve hours when the ventricles communicate with the subarachnoid space, where the absorption of cerebrospinal fluid normally takes place

Air introduced into the ventricles acts in no way differently from the air included at every intracranial operation. Following tumor extirpation especially, the resulting defect fills with air which, unless displaced by salt solution, is shut in when the dura and scalp are sutured. For a few days pending its absorption from tumor defects the patient may be conscious of the move-

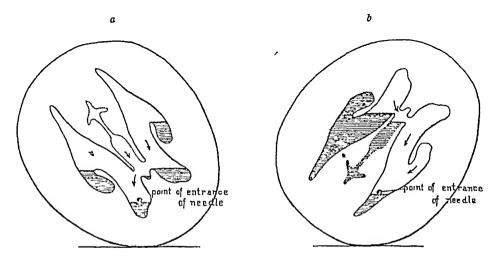


FIG 2—Diagrams showing relative amounts of cerebrospinal fluid that can be removed from a single ventricular puncture (1) when forehead is down (a) and (2) when occiput is down (b) Shaded area represents the fluid which remains in the ventricular system after the greatest possible quantity has been removed Unshaded area represents maximum quantity of air which can be injected to replace the fluid withdrawn It is evident that more fluid can be removed when the puncture is made anteriorly and the forehead is dependent

ment of the air when the head is turned, but its presence is without any other effects

The Value of Ventriculography—Even in the few cases here reported ventriculography has proven of great practical value. For the first time we have a means of diagnosing internal hydrocephalus in the early stages. Internal hydrocephalus is one of the most insidious diseases of the brain and is rarely diagnosed before a considerable amount of cortical destruction has resulted. This is true of adults as well as of children. With exact visualization of the ventricles the findings are pathognomonic. Not only the existence of hydrocephalus but its degree and the amount of brain destruction are at once evident from the ventriculogram.

In one case (in an infant six months old) an internal hydrocephalus was suspected from a bulging fontanelle, but the ventriculogram showed

<sup>&</sup>lt;sup>2</sup>Dandy and Blackfan Am J Dis Child, 1914, viii, 406, 1917, xiv, 424 Also J Am M Assoc, 1913, 1xi, 2216

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no enlargement of the ventricles Another child (three years old) remained drowsy for several days after apparent recovery from an attack of epidemic cerebrospinal meningitis. The spinal fluid was clear and contained no organisms. The ventricular fluid was turbid and organisms were present, the ventriculogram demonstrated a greatly enlarged ventricle. The diagnosis of obstructive internal hydrocephalus, clinically unsuspected, was made with absolute certainty from the ventriculogram.

In two other children measurements of the head were normal but hydrocephalus was suspected because of abnormally large fontanelles In each case the ventriculogram demonstrated ventricles which nearly filled the cranial chamber (Fig 5)

One of the most interesting diagnoses, made possible only through the ventriculogram, was in a colored child eight months old. The head was definitely larger than normal, indicating the probability of an internal hydrocephalus. Over the anterior fontanelle, but slightly to one side, was a protruding tumor suggesting a meningocele, and this diagnosis had been made. Air injected into the lateral ventricle passed directly into the tumor. In the lateral ventriculogram the tumor was seen to arise from the greatly distended ventricle by a narrow neck (Fig. 6). An anteroposterior ventriculogram showed this communication to be unilateral. The diagnosis of a ruptured cortex with a (false) ventricular hernia was established, and subsequently verified at necropsy

In another case a large cerebellar tumor was removed from a boy twelve years old. The large head, the marked convolutional atrophy of the skull, blindness, and the location of the tumor, made the diagnosis of internal hydrocephalus certain, but only the ventriculogram gave an accurate estimation of its advanced degree and the amount of brain destruction (Fig. 8)

Without a ventriculogram the diagnosis of internal hydrocephalus in children is frequently guess-work, with the ventriculogram the diagnosis is absolute

We have as yet not obtained a normal ventriculogram. In one of these cases the ventricle was small but not known to be normal. It is possible that one of the earliest signs of internal hydrocephalus may be alteration in the shape of the ventricle due to the pressure effects on parts of the wall which are least resistant. The obliteration of the angle between body and posterior horn in Fig. 5 (contrasted to Fig. 3) suggests this probability, but ventriculograms of the intervening stages and the normal are lacking

We have not yet applied ventriculography to adults, but expect to do so in all cases in which the diagnosis is obscure. In a box of twelve years the ventriculogram was even sharper than in younger children. In adults we should expect the ventriculogram to be at least as sharp or possibly even more so because of the greater contrast between the density of air and bone. Several possibilities are anticipated from ventriculograms in adults. (1) The enlarged ventricles in internal hydrocephalus should be absolutely defined

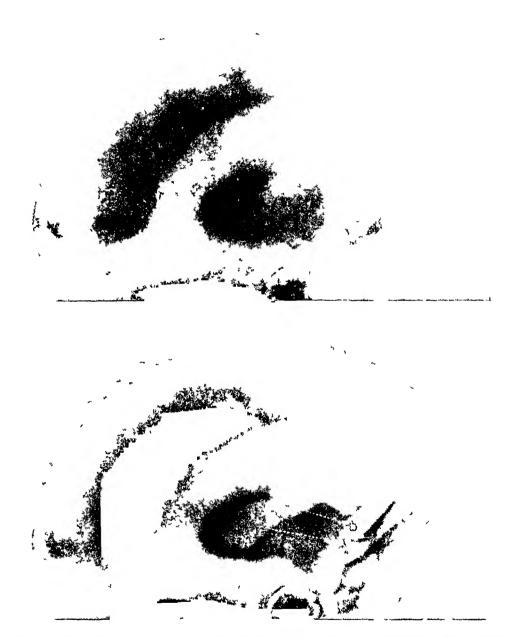


Fig. 3—Ventriculogram in a child three years old with tuberculous meningitis. The ventricle is slightly dilated an early obstructive hydrocephalus having resulted from closure of the foramina of Magendie and Luschka by evidate. The separation of the frontoparietal sutures also indicates intracranial pressure a third ventricle b probably the foramen of Monro. The body the posterior horn, and the descending horn of the lateral ventricle are obvious



[ I Fig. 4—Anteroposterior ventriculogram of Fig. 3. Note the unequal distribution of air on the two sides. The ventricle shadow is greatest in the body and descending horns owing to the depth of the column of air. The posterior curved and ventrical part of the ventricle shows as a lighter shadow communicating the two deeper shadows. The shadow is lighter because the smaller column of air gives relatively less penetration to the Rontgen rays. The curvature of the ventricles and the perspective are brought out by stereoscopic vision. a third ventricle

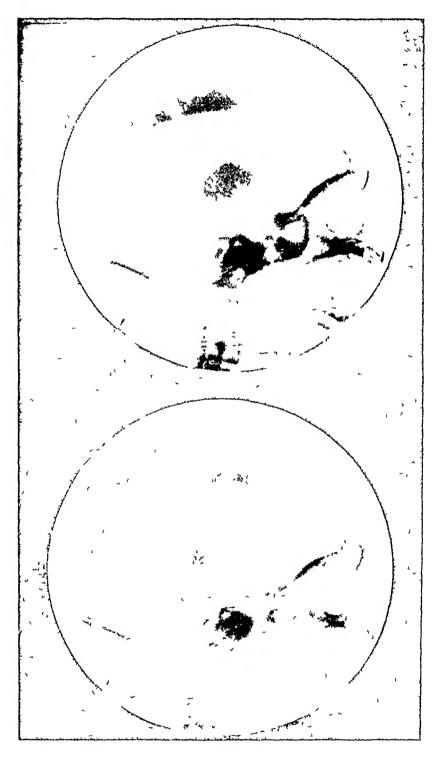


Fig. 5—Ventriculogram of moderately distended ventricle in a case of communicating hydrocephalus. The size of the head is normal. Note the obliteration of the more normal ventricular contour shown in Fig. 3. The posterior horn is supplanted by a diffuse posterior bulging. The deeper shadow in the anterior part of the ventricle is due to air in the opposite ventricle.

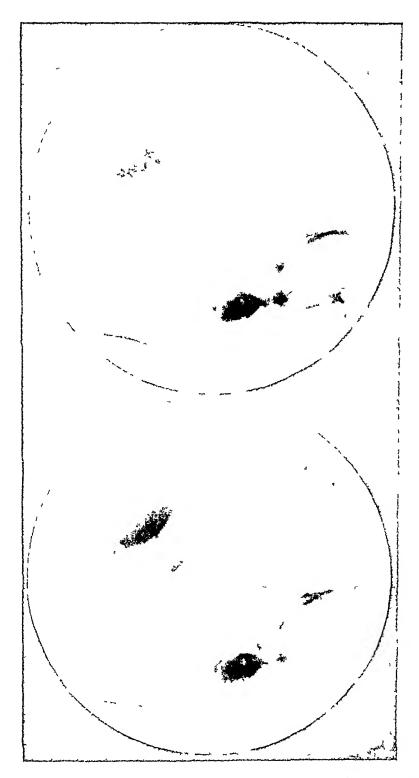


Fig. 6—Ventriculogram (lateral view) of a more distended ventricle in a fairly advanced case of communicating internal hydrocephalus. Note the ventricular hernia and its neck communicating with the anterosuperior part of the lateral ventricle. It was necessary to draw the hernia in the lower picture because the  $\lambda$ -ray shadow of the hernia on the  $\lambda$ -ray plate was so slight as to be visible only by an oblique or reflected light. The constriction in the centre of the ventricle is due to the fact that air does not fill the ventricle



Fig 7—Anteroposterior view of Fig 6 Note the fairly equal distribution of the air in the two ventricles. This is probably due to the more extensive communication due to the enlarged foramina of Monro a, third ventricle

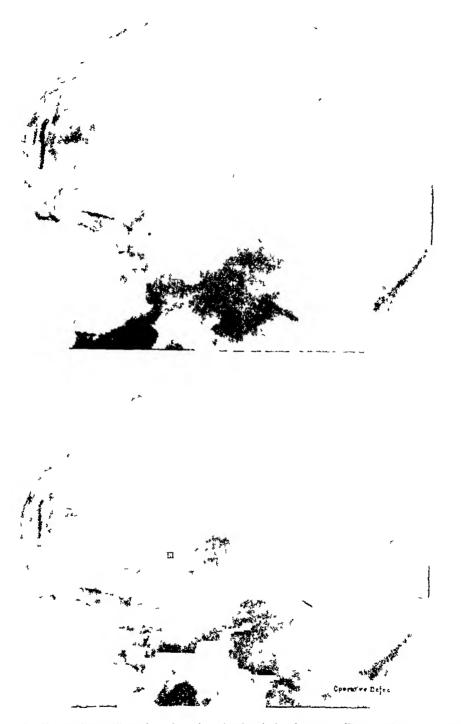


Fig. 8 —Ventriculogram (literal view) in a large head with closed sutures of the skull indicative of internal hydrocephalus is evident in the occipital and frontal regions. The markings are intensified by the air in the ventricles. III is third ventricle. The downward projection from the third ventricle is probably the infundibulum. The patient was twelve; ears old. A large cerebellar tumor had been removed.

#### **VENTRICULOGRAPHY**

(2) Tumors in either cerebral hemisphere may dislocate or compress the ventricle and in this way localize the neoplasm (3) Tumors growing into the ventricles may show a corresponding defect in the ventricular shadow

(4) A unilateral hydrocephalus may be demonstrable if the air cannot be made to enter the opposite ventricle

#### CONCLUSIONS

- The outlines of the lateral cerebral ventricles can be sharply outlined by the X-1ay if an is substituted for cerebrospinal fluid
- 2 The injection of air into the venticles has had no deleterious effects in twenty cases
- 3 Ventriculography has already proved of great practical value in the diagnosis and localization of many intracranial conditions. It is invaluable in internal hydrocephalus

Note—Explanation of Figures—Two pictures are shown in each figure number. The upper one is the untouched photographic reproduction of the X-ray plate, the lower is the same photograph retouched by Miss Norris in order to overcome photographic loss of detail, and especially to emphasize the lines and special points which would otherwise be lost to the reader

# LAMINECTOMY AND REGIONAL ANÆSTHESIA\* By Charles H Frazier, M D

OF PHILADELPHIA

Occasion arises in the performance of a laminectomy, as it does in other operations, when the attending risk of the procedure may be materially affected by the employment of ether narcosis. Under such circumstances I have sought for methods of conducting the operation without ether and have attempted to apply to the spinal operations methods of anæsthesia induced by novocaine that are applicable to other fields

Of the clinical type to which I refer as demanding the use of every safety measure and the elimination of every risk, I may cite, by way of illustration, the case of a woman upwards of sixty years of age who had been invalided for a number of years. Her weight was excessive, there had been evidence of cardiac decompensation and the phthalein test of renal function was alarmingly low Altogether the patient's condition was not such as to warrant any large surgical undertaking without real apprehension, but as her life was rendered miserable by the spinal lesion from which she suffered, operation seemed urgent. Wishing to throw about her every safeguard I decided to eliminate the influence of ether narcosis as a potential source of pneumonia or cardiac decompensation and carried out the operation, a laminectomy of the lower thoracic region, under novocaine. In the course of the operation, which lasted an hour and a half, largely for its psychic influence, the anæsthetizer was instructed to give inhalations of ether. At all times, the patient was conscious enough to answer when spoken to and at the conclusion of the operation the pulse rate was 72

While regional anæsthesia alone is mentioned in the title of this paper, it is desirable that one should be prepared to fall back upon certain supplemental measures, such, for example, as infiltration anæsthesia, nitrous-oxide anæsthesia and later on the stovaine block. To these we will subsequently refer

In outlining a zone of anæsthesia that followed a laminectomy and the division of four posterior spinal roots on the right side for the relief of pain, I observed a band of anæsthesia of the left side of the median line of the back. This band corresponded in length to the number of laminæ that had been removed and was about 5 cm wide (Fig I). The thought at once occurred to me that in the performance of the laminectomy I had destroyed the sensory innervation of the structures invaded in this operation and that if the nerve supply could be reached with the needle, a means was at hand whereby the principles of regional anæsthesia might be applied to this territory. From anatomical reference works I found the nerve supply of the structures under

<sup>\*</sup>Read before the American Surgical Association, June, 1917

#### LAMINECTOMY AND REGIONAL ANÆSTHESIA

consideration to be as follows. After its exit from the intervertebral foramen the spinal nerve divides into two main branches, the anterior and posterior divisions. The posterior primary divisions of the spinal nerves arise either as a single cord from the trunk formed by the union of the two roots or as two separate strands from the roots themselves. They turn dorsally almost immediately and divide into an internal (r. medialis) and an external (r lateralis) branch which supply the dorsal muscles and integument. Down to and including the sixth thoracic nerve the internal branches are mainly cutaneous and the external entirely muscular. From the seventh thoracic down the reverse condition maintains (Piersol)

As the latter branches, the rami posterius lateralis et medialis, supply the structures that are invaded in a laminectomy, the question arose as to whether it was feasible to inject these branches with reasonable accuracy. For various anatomical reasons it became evident that a more practical solution of the problem was the injection of the parent trunks. On an earlier occasion my interest in the technic of injecting the intercostal nerves had been aroused in connection with the treatment of severe and intractable forms of intercostal neuralgia with alcoholic injections. I had directed Dr. W. A. Sawyer, at the time a member of my Staff, in an anatomical investigation on the feasibility of the injection of the intercostal nerves. The method which he elaborated is that which I have adopted

To put this method into practice one must be familiar with certain anatomical relationships To orientate the intervertebral foramen the mid-point between the transverse processes serves as the guide The interval between the transverse processes has been estimated as 20 cm to the right or The location of the intertransverse spaces must be left of the median line determined in the thoracic region by palpation, although in the lumbar region the tip of the spinous process is a little above the lower border of the trans-But in the thoracic region, verse process of the corresponding vertebra having determined the location of one intertransverse space, the location of those above or below is not difficult, since the distance between them is represented as 25 cm and is fairly uniform. With regard to the depth to which the needle be inserted, the intervertebral foramen should be reached at a distance of 3 cm in the upper thoracic and 4 cm in the lower thoracic These measurements coincide with those published and lumbar regions by Allen (Figs 2 and 3)

A matter of real import in the technic of injection is the direction in which the needle must be inserted. If the needle be inserted at an angle with the transverse midline of less than 45 degrees, the needle may pass through the intervertebral foramen, possibly into the cord substance. On the other hand, if the needle be directed at an angle precisely of 45 degrees or a little less the danger is averted. As an additional guide, Sawyer found that the needle should be directed at an angle of 35 degrees to the cutaneous surface. To determine these angles, measurements may be made with the aid of a protractor.

#### CHARLES H FRAZIER

Preliminary to the operation morphine sulphate gr  $^{1}/_{0}$  and scopolamine gr  $^{1}/_{200}$  are given hypodermically, and if necessary an eighth of a grain of morphine may be given during the operation. With the patient in position a vertical line is drawn corresponding to the line of the spinous processes. Parallel to this median line are drawn two vertical lines 29 cm to either side, and at a point corresponding to the space between the transverse processes a transverse line is projected at right angles to the midline

The intersection of the transverse and lateral vertical lines marks the points at which the needle is introduced. After the location of the first intertiansverse space has been identified by the successful injection of one nerve, as many more transverse lines are projected as there are nerves to be injected at a distance of 25 cm above or below the first point of injection. Here again the intersection of transverse and vertical lines marks the points of successive injection (Figs 4 and 5).

With these topographical landmarks the surgeon proceeds with the injection, provided with a solution of 05 novocaine, a hypodermic needle, one platinum needle, a Record syringe, a centimetre scale and protractor The skin and subcutaneous tissues are infiltrated with the novocaine solution and the platinum needle is then introduced at the proper angle, that is, at an angle of 45 degrees or a little less to the transverse line and of 35 degrees with the cutaneous surface. The distance to which the needle must be advanced will vary according to whether the individual be lean or stout On the average the distance to the nerve in the upper thoracic is 3 cm and in the lower thoracic or lumbar regions 4 cm. When the needle comes in contact with the nerve the patient will at first experience a sharp pain, referred to the terminal distribution of the nerve, soon allayed by the injection of a few drops of the solution. At each injection 5 to 10 cc are used according to whether the injection be made directly into the nerve In the average case, where fewer laminæ are to be removed, it will be necessary to inject four right and four left spinal nerves

Doubt may arise in the minds of some as to the possible toxic effects of the drug should the solution penetrate the dural sac. With this in mind, Sawyei in his observations on the cadaver injected a solution of methyl blue with a hypodermic needle directly into the nerve root, but on no occasion was a trace of the stained fluid found either within the dural sac or the cord, and he concluded, therefore, that the possible danger of the fluid reaching the cord directly or indirectly was remote. However, this question of the relative toxicity of paravertebral and subcutaneous injections has occurred to others and has been made the subject of experimental investigation, notably by Murya. Using a novocaine solution stained with methylene blue the latter discovered the dye in the urine ten to twenty minutes after subcutaneous, and five to ten minutes after paravertebral, injections. To safeguard the individual Murya proposes a solution with adrenalin to delay absorption and a 5 per cent gelatin-saline solution to delay diffusion. Al-



FIG I—Territorial distribution of the cutaneous rami from the posterior primary divisions of the spinal nerves (posterior view)—From the effect of trauma or over-stretching perhaps division in the course of laminectomy—the function of these nerves has been abolished—so that there is an area of anæsthesia 4 or 5 cm—on either side of the spinal column—This is the anæsthesia which should be procured by the injection of the intercostal nerves according to the technic of regional anæsthesia

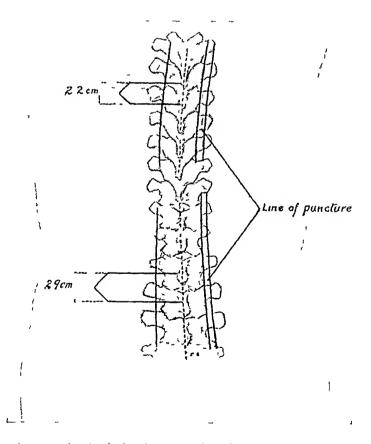
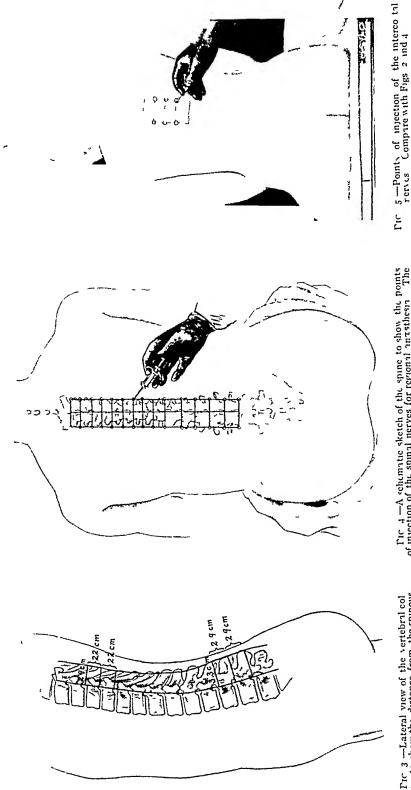


Fig 2—This schematic sketch of the thoracic and lumbar spines indicates the distance between the transverse processes in these two regions. The vertical lines 2 9 cm from the midline. The distance between the mid-point of the spaces between the transverse processes in the thoracic region is 2 2 cm and in the lumbar 2 9 cm.



Fir 3—Lateral view of the vertebril column to show the distince from the spinous processes to the intervertebril forming and the distances between the intervertebril foramina in the thoricic and lumbar region (after Allen)

Fig. 4—A schematic sketch of the spine to show the points of injection of the spinal nerves for regional americals are 2 ocm from the median line, the transverse lines pass through the spaces between the transverse processes

### , LAMINECTOMY AND REGIONAL ANÆSTHESIA

though I have not as yet used this solution, it appeals to me as having merit and well worthy of trial

As with regional anæsthesia elsewhere, owing to anatomical variations and other considerations, the degree of anæsthesia may not be complete enough in all cases to conduct the operation throughout without pain. Under such circumstances supplemental injections of novocaine solution may be made, especially in the removal of the spinous processes and laminæ when the needle is introduced directly into the periosteum. Or if need be at this stage for a few moments one may resort to nitrous-oxide anæsthesia

After the spinal canal has been opened subsequent manipulations may require resource to other methods of anæsthesia according to the object to be attained. For example, in the removal of tumors attached to the roots or in division of the posterior roots, some method must be adopted of controlling or inhibiting pain, and for this purpose I have resorted to the application of stovaine on a pledget of cotton. The use of stovaine in this way was introduced in my clinic many years ago for an entirely different purpose. Impressed with the fact that manipulation of the posterior roots was an important factor in the production of shock, I searched for a measure of prevention and, partly from clinical and partly from experimental observations, concluded that the stovaine block offered the best protection. A thin pledget of cotton is moistened with a 4 per cent solution of stovaine and brought in contact with cord and roots at the level of operation.

Regional anæsthesia is appropriate chiefly for operations in the thoracic region. While a method of paravertebral anæsthesia in the cervical region has been elaborated by Braun, the proximity of the phrenic centre to the level of injection at least arouses one's apprehension as to the safety of the practice and for this reason I have purposely avoided it. Infiltration anæsthesia serves as an excellent substitute for regional anæsthesia and I found it perfectly feasible in a patient who, because of pulmonary tuberculosis, seemed an unfit subject for ether narcosis. Four laminæ were removed and the inspection of the several aspects of the cord was accomplished without discomfort to the patient. Throughout the operation the patient complained of pain only when the posterior roots were disturbed and had I been familial at that time with the use of the stovaine block every step of the operation could have been made painless

When called upon to perform a laminectomy in the lumbar region, spinal anæsthesia is the method of choice because it is equally, if not more, effective and the technic less complicated. With one insertion of the needle one accomplishes what is difficult by the regional method with eight to ten. The first resection of the posterior roots for spasticity in my clinic was carried out under spinal anæsthesia, and because of the necessary manipulation of the roots this form of anæsthesia proved particularly appropriate

In addition to the examples already cited, where I have found it desirable to avoid ether narcosis, there should be included injuries to the cervical cord. The accompanying paralysis of the accessory muscles of respiration predis-

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poses the patient to pulmonary congestion, and use of ether is properly looked upon as injudicious and it is quite feasible to perform an exploratory laminectomy without it

My purpose in discussing methods of anæsthesia other than those usually in vogue has been chiefly to point to ways of reducing such risks as there may be attached to operations upon the spine. By attention to such details, the mortality has been so reduced that an exploratory laminectomy per se has no more attending dangers than an exploratory laparotomy. All told, there have been but four operative deaths in my clinic following laminectomy, and two of these could not be charged against the operation—one, an acute osteomyelitis of the spine in a profoundly septic patient, the other, a grave injury to the cervical cord. Of the two remaining deaths both followed resection of the posterior roots, one in a defective child of five, the other in an adult

There are important matters of technic other than the solution of the anæsthetic to which I briefly allude in closing an ample exposure implying the removal in the first instance of an adequate number of laminæ, X-ray identification of at least one lamina before the operation, so that the opening corresponds precisely to the location of the lesion, coffer-damming with cotton the spaces on either side of the dural flaps to prevent drops of blood gaining access to the dural sac, a potential factor in the formation of post-operative adhesions, the gentlest manipulation of the cord or roots and the stovaine block as prophylactic against shock, minute closure of the dural incision with fine needles and silk to prevent the escape of cerebrospinal fluid, and careful juxtaposition of each layer muscle, muscle sheath, and intervertebral aponeurosis, together with superficial fascia to ensure maintenance of function and the avoidance of disability after the removal of spines and laminæ. Observing these essential features the performance of a laminectomy may be resorted to with anticipation of the patient's recovery in all but exceptional instances.

# THE ADVISABILITY OF TOTALLY EXCISING BOTH PECTORAL MUSCLES IN THE RADICAL OPERATION FOR CANCER OF THE BREAST \*

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JUDGING from the recent literature with reference to the two methods of radical operation for cancer of the breast, as originally proposed in 1894 (Annals of Surgery, 1894, xx, p 495, and New York Medical Record, December 15, 1894), it would seem that the majority of surgeons have accepted the excision of the deep tissues from the axilla toward the chest. forming the pedicle of the mass alongside the border of the sternum of them are also making use of Handley's addition to the radical operation, which consists in extirpating the anterior sheath of the recti muscles in the triangle bounded by the ensiform process and upper portion of the two costal arches, and necessitates placing the lower (inner) angle of the skin incision in the median line, about midway between umbilicus and lower end of the sternum, instead of over the sternum close to the inner border of the opposite mammary gland Handley's addition has the technical advantage of giving great mobility to the two skin flaps, which, when reflected widely, expose the seat of the disease, so that their borders usually can be approximated by sutures throughout, rendering skin grafting unnecessary

However, there is one important point in the technic of the radical operation, regarding which there still seems to exist considerable difference of opinion, and that is the question of excising the pectoral muscles in their entirety

To contribute to the discussion of this question is the object of this paper Anatomy—The pectoralis major muscle is an adductor of the arm, the minor pulls down the shoulder or, when the shoulder is at iest, raises the ribs. The major takes its origin in two divisions, from the sternal extremity of the clavicle—" clavicular portion"—and from the anterior surface of the steinum and the cartilages of the six upper ribs, often also the aponeurosis of the external oblique abdominal muscle—sternocostal—or, briefly, "sternal portion". The two portions after being enjoined into one broad strong tendon, two inches wide, insert on the spine of the major tubercle of the humerus, about an equal distance away from the anatomical neck of its head. The pectoralis minor takes its origin from the external surface of the second to fifth rib and inserts on the coracoid process of the scapula

It is probable, that after extirpation of the two muscles, the combined

<sup>\*</sup>Read before the New York Surgical Society, April 24, 1918

work of the serratus anticus major, teres major and the two rhomboids assume their function Still it is natural that the gross power of adducting the arm will be permanently decreased except continuous gymnastic exercise of the substituting muscles makes up for the defect

The blood supply of the clavicular portion of the major and the belly of the minor is derived principally from the rami thoracici of the thoraco-acromial artery, the first branch of the axillary artery Sometimes the first of the rami thoracici leaves the axillary artery direct, it is then called arteria thoracica suprema. The sternal portion of the muscle receives its blood mostly from the rami perforantes of the internal mammary artery. The serratus anticus major muscle and the external portion of the mammary gland are fed by the long thoracic artery.

The veins return the blood as usual to the namesakes of the respective arteries

The nerves of both pectoral muscles are represented by the anterior thoracic nerves, branches of the supraclavicular portion of the brachial plexus. It has been stated that the nerve supply of the pectoralis major muscle is arranged in such a manner as to produce paralysis of the clavicular portion when its sternal position is extirpated with the breast

The *lymph-vessels* of the breast itself—there usually exists an internal and an external collecting lymphatic trunk—discharge into one or two glands placed on the inner wall of the axilla on the third digitation of the serratus magnus. These glands constitute the supero-internal group of the thoracic chain of axillary glands.

The lymphatics of the two pectoral muscles run towards the subclavian glands or to the thoracic group of the axillary glands. A further portion of the lymph of the pectoral muscles takes its way through the trunks which escort the perforantes plexuses and discharge into the glands of the internal mammary chain that cluster around the inner surface of the junction of the second to seventh rib cartilage and the sternum. Behind the manubrium sterni the latter form a mammary truncus, right and left, which empties into the thoracic ducts. The lymph-vessels of the anterior mediastinum, on either side of the sternum, communicate across the posterior surface of the latter.

Clinical observation and autopsies have shown that this part of the lymph current usually becomes charged with cancer cells only at a late stage of the disease

Besides the two collecting trunks of the breast itself, mentioned before, accessory channels are not infrequently met with. There are three of this type, the axillary, subclavian and internal mammary, of these the subclavian is the most important one with regard to the subject under discussion. In its course now and then lymphatic glands are met with, the so-called interpectoral and retropectoral glands. I have repeatedly met these glands in the course of my work, first in two cases operated upon in the early nineties, when it was customary to remove the pectoral muscles after ablation of the

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breast, as the second stage of the operation This finding was one of the principal reasons next to the saving of blood that induced me to leave the space between the two muscles undisturbed, and extirpate both muscles together and entirely in one mass (see technic of the operation, published in 1894) The occasional presence of these glands and the correctness of the operative procedure, worked out on basis of this clinical observation, was later corroborated by Grossmann and Rotter, by experimental and microscopic research Grossmann succeeded in three out of thirty subjects, when injecting from the mammary gland the lymph-bearing vessels which perforate the great pectoral, in thus making clearly visible a lymphatic trunk, which detached itself from the posterior surface of the mamma, then perforated the pectoralis major and running between this muscle and the pectoralis minor reached the subclavian glands This trunk was a satellite of the superior thoracic aftery or of the thoracica suprema (see above), which latter enters into the space between the pectoralis major and minor, and showed in its course two or three small glandular nodules According to Rotter, who, on careful dissection of specimens of cancer of the breast, found this accessory subclavian channel of Giossmann, these inter- or retropectoral glands exist in nearly one-half the cases of breast carcinoma and cannot be recognized with the pectoral muscles in situ

Rodman observed retropectoral enlarged lymph-nodes in two cases

Regarding the lymph current in the two portions of the pectoralis major muscle, it is to be assumed that in some individuals there exist communicating branches. Division of the great pectoral muscle in the groove between the two portions necessarily divides, ie, opens, such lymph-vessels, which may be filled with cancer cells. The skin and subcutaneous tissue of the two upper quadiants of the breast often discharge their lymph directly into the supraclavicular group of glands, the lymph-vessels passing in front of the clavicle

Further details of this important chapter of lymph-vessel arrangement and distribution can be found on pages 208 to 227 in "The Lymphatics" by Delamere, Poirier and Cunéo, translated by Leaf

One of the generally accepted laws in operations for carcinoma is to keep in reverential distance from the seat of the disease—not to enter the infected area if it can possibly be avoided, in other words, work within healthy tissue as far as possible, and try to lift out the tumor "en masse" with lymph-vessels and lymph-glands—The more completely and in accordance with anatomical relations this is accomplished, the better the chances for a successful and permanent issue of the radical operation

Nowhere in the body are conditions more favorable for obtaining such a result than with cancer of the breast, provided the case is not too far advanced

The upper and lower skin flaps properly reflected to the anatomical landmarks expose the seat of the malignant invasion. I have come to consider the removal of the skin of the entire breast a necessity, and have

abandoned the division of the superior flap at right angles to the direction of the breast incision toward the middle of the clavicle, as first proposed by me in 1894 (Med Rec, loc cit) Some surgeons, among them Parkei Syms, of New York City, who has done so much for a better understanding of this radical operation, still adhere to this part of the original technic. I lay great stress upon keeping the knife above the pectoral fascia and forming the flaps with as little fat tissue adherent as possible, just enough to eliminate all the fear of subsequent gangrene At the very base of the two flaps the exposed fascias are incised parallel with the base line of the skin flaps The fascia covering the latissimus dorsi is usually left alone, as not pertaining to the infected area, except the growth has developed in the extension of the glandular breast tissue close to the axilla or in an aberrant portion of the mamma in this region. In such cases, as Handley particularly points out, the deep fascia has to be excised in the deltoid region as well as far backward over the surface of the latissimus dorsi. The border of the latter muscle forms the posterior landmark for reflection of the lower flap in the uncomplicated case

As regards the excision of the deeper tissues, it seems best to commence with Handley's addition to the radical operation, namely, the removal of the upper portion of the anterior sheath of the two recti This is often a somewhat bloody as well as cumbersome procedure on account of the firm interwovenness of the sheaths with the linea alba However, with a little patience these sheaths can be lifted in one piece, in conjunction with some of the bundles and the fascia covering the serratus anticus major The greater part of the latter's fascia is also removed and carefully dissected upward, with such digitations of the muscle as lie in direct contact with the deep surface of the breast, until the lowest bundles of the pectoral muscles are reached. It seems wise to include in this extirpation also a superficial layer of the digitations of the external oblique which arise from the fifth and sixth ribs (Handley) During this work properitoneal fat is often exposed in the median line. This, however, does not need to make us fear the later occurrence of a ventral herma, even if the recti muscles are not or cannot be stitched together in the median line, at least I have never seen it

If, now, the lower border of the cephalic vein has been clearly exposed and followed up toward the clavicle, and thus the deltoid has been separated from the upper outer border of the major pectoral within the groove dividing these two muscles, and if further, the tendon of the pectoralis major muscle has been approached from below by following the lower border of the muscle in the axilla upward toward the humerus, the next step is to push the closed blades of a large Cooper's scissors, followed by the surgeon's gloved left forefinger, through the very beginning of the first bundles of the pectoralis major muscle, next to its tendon. The primary total division of this tendon, then following, makes the extirpation of the entire major pectoral muscle a matter of forced anatomical sequence. Taking the course

of the lower border of the exposed cephalic vein as a guide, the knife quickly reaches the clavicle By now taking a gauze wipe and pressing it with the left hand on to the muscle fibres in a downward direction, thus putting the individual muscle fibres on the stretch, it is a very easy matter for the operator to cut through the pectoralis major muscle alongside the lower border of the clavicle up to a point somewhat beyond the sternocleido junction, without dividing the vessel plexuses below The latter invariably come clearly into view, are caught by two clamps and divided in between ing hemorrhage is hardly ever encountered, and can, with some care, always be avoided With the tendon of the pectoralis minoi sharply or bluntly approached, and then also surrounded with the surgeon's left forefinger and divided at the coracoid process, the inferior clavicular region is wonderfully well exposed One horizontal sweep of the knife through the deep fascia from the axilla to the clavicle lays open the axillary and subclavian vessels and enables us to bloodlessly remove the axillary fat plus glands in one mass, the whole always remaining attached to the bulk of the area to be removed, a procedure familiar to every surgeon who once has done this excision from the axilla toward the sternum Having clearly exposed and freed the lower boi der of the subclavian vein up to the spot where it dips beneath the clavicle, the superior clean excision is finished. The operation, so far, has been attended with an extremely small loss of blood. The lymph-vessels of the breast as such have remained in "closed" communication with the corresponding lymphatic glands in the axilla and subclavicular region gland lifted out very near the angle between subclavian vein and chest wall is to be handed to the pathologist for immediate frozen section examination If it shows carcinoma, the supraclavicular space is cleaned out at the same This additional operation if required is best done as the last step in the course of the radical operation Thus the pathologist will have time for a study of the frozen sections, while the surgeon completes the excision of the cancerous breast All that then remains to be done is the formation and division of the pedicle of the mass 
In this step, particularly, the principle of keeping out of the infected area can be beautifully carried out in the type of radical operation that works from the shoulder toward the sternum

If the case in hand is an advanced one, the subscapular space is also cleaned out, if possible with the preservation of the subscapular nerves. If, on the other hand, the case seems to be an early one, this part of the operation may be omitted. The blade of the knife is then turned toward the chest obliquely within the hollow of the funnel formed by the chest wall and the reflected lower skin-flap and, without entering the subscapular fat, the superior portion of the fascia of the serratus anticus major muscle is prepared upward toward the outer border of the pectoralis minor muscle. This fascia was incised before, parallel with the base of the lower skin flap, at the time when the fascias in the epigastric regions were removed. As soon as the bundles of the pectoralis minor are reached the first assistant takes hold of the mass, not with sharp retractors, but with his hands, and lifts it up

without exerting any pull whatever He is merely to support it, as otherwise he is bound to strip periosteum off some rib, or, as more frequently happens, perichondrium from one or more rib cartilages, which may result in cartilage necrosis and delay wound healing

Keeping with the knife as closely as possible to the chest-wall, the operator will be able to see the perforantes arteries and clamp them before they are divided. If cut before clamping, the spurting vessels are also easily caught However, blood thus lost might well be saved. Finally, the muscular pedicle, extending in a vertical direction, is amputated with knife or scissors parallel with the border of the sternum.

The decision as to whether the subscapular space should be cleaned out, ie, whether the connective tissue, fat and fascia covering the subscapular muscle should be excised, must be left to the individual surgeon. It must also be left to his discretion to decide whether or not the supraclavicular space should be cleaned of its contents.

In stripping the fat and connective tissue off the intercostal muscles and ribs at and inward from the place where the subclavian vein disappears beneath the clavicle, the lymphatic vessels communicating with the nodes above the collar bone, of course, have been opened, a fact which may represent a disadvantage to the patient. Unfortunately, this cannot be avoided, except we make it a rule to divide the clavicle in every case and then try to remove the package of lymphatic nodes and vessels below and above in one continuous mass.

From the purely radical point of view, such a demand could be justly established However, we know from experience that carcinomatous involvement of the supraclavicular glands means death of the patient in more than 95 per cent of the cases On the other hand, we know that many patients have remained perfectly well after the radical operation, for ten to twenty years and longer, in fact, have to be considered completely cured, yet the supraclavicular glands were not removed. The point simply is that the glands are not often invaded by the disease Therefore, to add typical cleaning-out of the lymphatic system on both sides of the clavicle, as a routine measure in the radical operation for cancer of the breast, does not appear to be called for, and therefore should not be done But it should be done if there is the shadow of a doubt that the disease has reached the The result of the microscopical examination of the innermost infraclavicular gland during the operation, as mentioned above, will have to be the guide, also the fact whether a tumor in one of the two upper quadrants of the breast has become adherent to the skin (see above) Early extirpation of the supraclavicular glands at a time when they are not yet adherent to muscles, veins and thoracic duct, will certainly greatly improve the prognosis of the given case Additional division of the clavicle must be left to the judgment of the individual operator

Proceeding in the manner just described, the seat of the disease is not entered at any step of the operation, as far as this is at all possible from an

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operative point of view. The knife works altogether outside of the infected area. Both pectoral muscles are completely excised from their insertion to their origin, the lymphatic system in and between them is left undisturbed. The operation is radical, anatomical and typical. It is feasible within a short space of time and can be carried out with comparatively little loss of blood.

The question naturally arises. Why is this complete excision of both muscles still a mooted point in the technic of the radical operation for cancer of the breast? Why was this method of continuously working with the knife outside of the seat of the carcinoma, this possibility of lifting out the entire invaded field in its normal, undisturbed anatomical relation, not generally accepted from the start, after its proposal in 1894?

The reasons seem to have been twofold

- I Because Halsted, by a peculiar coincidence, published his method of radical breast operation from the sternum toward the shoulder with preservation of the clavicular portion of the great pectoral muscle and the division, dissection and resuturing of the pectoralis minor muscle, simultaneously with the procedure described above, and naturally, the weight of his authority turned the scales toward his method of procedure
- 2 Because the total extinpation of both pectorals was considered mutilating and unnecessarily radical by many surgeons

  To-day, after the plan of the radical breast operation devised and published

To-day, after the plan of the radical breast operation devised and published in New York, twenty-four years ago, has been so generally accepted, it seems hardly necessary to discuss the objections under No 2 That the operation is neither mutilating nor unnecessarily radical is now generally conceded

The preservation of the clavicular portion of the major pectoral muscle makes extremely little difference in the cosmetic result. Besides, the operating field is later on always covered by the patient's dress. The functional result of the arm, on the other hand, is absolutely perfect. The "statue of Liberty" posture, as I ventured to call the result in 1904, can be obtained in every instance. If it is not obtained, this is not the operator's fault, but due to the negligence of the patient in failing to carry out the surgeon's directions for proper exercises. Lastly, it has been stated, as mentioned above, that the arrangement of the nerve supply of the pectoralis major muscle involves paralysis of the retained clavicular portion after the excision of the sternal portion. I cannot speak from personal experience in this matter, as I have never left the clavicular portion of the muscle behind

Rodman, fearing that stiffness of the arm would result if the muscles were completely excised, left their tendon and the nearest portion of the major pectoral muscle adjacent to it in situ and cut through this part of the muscle's belly at right angles to its fibres. In view of what has been said above, it is difficult to see either the advisability or the necessity for such a variation of the operation. All my patients have been satisfied with the functional result of the operation, while, of course, the gross power of the

<sup>&</sup>lt;sup>1</sup> See above under anatomy of the lymphatic distribution

arm is reduced in proportion to the muscular mass removed, usually the bellies of the substituting muscles, if sufficiently exercised, acquire considerable compensating strength

It still remains to be proven that the operation is not too radical To-day it is a generally accepted principle to extirpate completely a muscle involved in malignant disease, i.e., from tendon to its origin. Heidenhain emphasized this necessity as early as 1889 in his classical essay "On the Causes of Local Recurrence of Cancer after Amputation of the Breast" 2

For this reason I also consider it inadvisable to preserve portions of the muscle for the purpose of covering the brachial nerve plexus and the large blood-vessels, in order to try and avoid by such procedure the later appearance of neuralgia and ædema of the arm. I have rarely seen persistent neuralgia subsequent to the radical operation. Should chronic ædema set in later, it can be overcome by dividing the deep fascia in a number of places (W. E. Sistrunk, Elephantiasis Treated by Kondoleon Operation. From the Mayo Clinic, Surgery, Gynecology and Obstetrics, vol. XVI, April, 1918, p. 388.)

The possibility that communicating 'lymph-vessels exist between the two portions of the pectoralis major muscle, and the anatomical fact that infected lymph-nodes with afferent and efferent lymph-vessels are encountered now and then between and beneath the two pectoral muscles, ought to be sufficient proof, it seems to me, to convince the thinking surgeon that he cannot be too radical in dealing with this treacherous disease

A recent experience brought this home to me most strongly. On examining the specimen obtained at one of my latest radical operations for a scirrhus in the upper quadrant of the breast, I found that a small tumor which before operation had appeared well movable with the breast in all directions had grown in cylindrical fashion perpendicularly through both pectoral muscles. The circumference of the cylinder was not larger than a 50-cent piece. It had grown like a wedge in a sagittal line. When dividing the bundles of the minor pectoral muscle below the breast and parallel with the surface of the chest in the final stage of the operation, I left a very short stump of the pectoralis minor muscle attached to the chest for more convenient preparation of the field for grafting, should a skin defect ensue in spite of Handley's addition. In view of the findings revealed on closer examination of the specimen after the completion of the operation, I regret having left this stump. What I should have done is to amputate the pectoralis minor fibres at once with the mass as close to the ribs as possible,

<sup>&</sup>lt;sup>2</sup>Von Langenbeck's Archiv, 1889, vol xxxx, p 97

<sup>&</sup>lt;sup>2</sup>A short stump of the pectoralis minor muscle, about one-sixth to one-quarter inch in length, can be safely left behind without fear of courting a local recurrence of the tumor. It is a well-known fact that within the belly of the pectoralis minor muscle cancer cells are never encountered, except in far advanced cases. What has been found with reference to this muscle are retropectoral lymphnodes. And these, of course, are not met with at the place of origin of the muscle over the surface of the ribs, but rather up on the chest, underneath its belly

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or still better, I should have resected the underlying portion of the two ribs with their periosteum and intercostal tissues. This experience, which I have never had before, certainly has taught me to palpate for the lower portion of the tumor during the operation, before finally dividing the muscle, while working beneath the breast in finishing the radical operation. As matters stood in this case, only a thin layer of uninvaded muscle fibres separated the infiltrating tumor from the chest wall. The prognosis consequently is more dubious than otherwise, in spite of the subsequent prolonged X-ray cross-firing

That the final results of our operations for cancer of the breast have been most happily changed since the advent of more radical methods, every surgeon knows and recognizes to-day. Most strikingly was this change for the better demonstrated to me when, in 1904 and 1907, ten and thirteen years after I first carried out the radical operation, I made my first statistical collection as regards end results (Joun Am Med Ass'n, July, 1905, and Sung, Gyn and Obstetrics, July, 1907). Whereas at the end of the first decade of surgical work from 1884 to 1894 I could not find a single one of my patients subjected to breast amputation, still alive, I then could state that three (Nos 1, 2 and 6) of the very first patients in whom I had done the radical operation in 1894, 1895 and 1896 were in perfect health

No 4 of the series, who was operated upon in November, 1895, had died in July, 1902, of endocarditis, without symptoms of a recurrence of the cancer (coroner's case)

Nos I and 2 of that series are alive to-day (1918) and cured of their cancer, as proven by recent personal examination. No 6, operated upon in 1896, lived sixteen years after the operation and then succumbed to semile marasmus

Of course, personal statistics do not prove much for or against a type of operation, as far as a cure of the malignant growth or prolongation of life is concerned, if the surgeon does not select his cases, but operates as they come along, refusing operation only if the disease has too far advanced After all, it is the so-called virulence of the agent that produces cancer which determines the final result of our surgical work. That this agent will yet be proven to be a parasite similar to the spirochæta pallida in syphilis, or a microbe, is my personal belief

But it stands to reason that by keeping entirely outside of the seat of the disease,—a procedure that certainly appears possible in cases of cancer of the breast that come to operation at an earlier stage of the trouble,—we shall have done our share in preventing not only local or regional recurrence, but perhaps also metastasis

Of course, some surgeons may say "I have never removed the clavicular portion of the great pectoral muscle and have always left the minor behind, and yet from 30 to 40 per cent of my patients have lived three, five and more years after the operation without recurrence" However, the point

in question is not because Case X and Y got well after the radical operation without complete excision of the two muscles, therefore such excision is unnecessary. The question rather is. How many of the patients may have developed regional recurrence and metastasis because the space between the two portions of the pectoralis major muscle and particularly that between the pectoralis major and minor was entered with hands and instruments during the operation, and portions of the muscle were left behind?

The total extirpation of both pectoral muscles in their undisturbed and uninvaded anatomical connection and relation to the breast, as above described at length and also originally set forth in the author's previous articles on the subject (loc cit), offers an additional safeguard not only against local and regional recurrence, but in all probability also against metastasis

The total extirpation of both pectoral muscles in every case of radical operation for cancer of the breast, certainly is logical and, as a surgical procedure, clearly indicated, particularly in view of the possible lymphatic arrangement. The author therefore holds that it should be generally adopted

# THE INTERRELATION OF STASIS, PTOSIS AND INERTIA OF THE INTESTINAL TRACT\*

# By J Christopher O'Day, M.D of Honolulu, Hawaii (formerly of portland, origon)

The interrelation of stasis, ptosis and inertia of the intestinal tract is not a close one. That stasis and ptosis have been observed in such intimacy as to warrant the conclusion that a relationship might exist between the two will be admitted, but as a matter of fact, the association is so infrequent that rightfully it may be regarded as the exception proving the rule that the two are seldom depending, one upon the other. This statement is made as the culmination of research and study carried on at odd intervals within the past ten years and in which have been included the conclusions of others who have given adequate time and thought to the subject. Conspicuous among those from whom my best notions of enteric stagnation and visceroptosis have been derived are. Robert C. Coffey, Kenneth A. J. MacKenzie, Miles F. Porter, A. E. Rockey, J. Rilus Eastman, W. J. and C. H. Mayo, Sir Arbuthnot Lane and my former teacher, the late lamented John B. Murphy

When disappointment was the ultimate result of what, at the time, seemed to be faultless reasoning and deductions, and accumulated experience forced the relinquishment of methods previously extolled as correct, our pride was greatly relieved when it became known that we were a small group of many who likewise had been similarly affected. However, as the open confessions came in, confessions of failures, mind you, from the great number, it was observed that a given percentage of cures had obtained. When interpretation of this percentage of cures was finally established, the whole affair immediately fell under a class distinction which readily divided itself under three heads, namely visceral-stasis, visceroptosis and visceral-inertia. With the first of these, surgery was given a permanent place

When intestinal stasis was the paramount interest of the world's surgery, confusing of the above three was responsible for many of suigical failures during the initial attempts at solving the problem

But during those days when so many of us were blundering about it because of the confusion in our minds relative to the subject, the entire experience might have been most contrite had it not brought forth the facts which henceforth were to enable us to determine the cases that were surgical and those that were not, returning us, so to speak, to that happier time when

<sup>\*</sup>This paper was to have been read at the 1918 Annual Meeting of the Oregon Medical Society in June, but it became the wish of the programme committee to secure an exclusive non-membership programme. At their request and as a member of the Oregon Society, I cheerfully withdraw from the original schedule—J Chris O'Day

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our knowledge of bowel stagnation had not been muddled by the inclusion of visceroptosis and visceral-inertia

At that time, intestinal stasis was generally, and I may add, correctly, understood to be the result of some local interference with normal peristalsis. We also had definite notions as to where such interference was most likely to take place. Beginning with the pylorus, then reckoning downward, we enumerated duodenal-jejunal junction, ileocæcal opening, and the colon itself. To these, R. C. Coffey added the junction of the first and second portion of the duodenum which corresponds to the position of the hepatic vessels and ducts. We also recognized another fact. It was this. No matter where the point of origin, the whole scheme of intestinal motility becomes embarrassed in such a definite way that the ultimate delivery into the colon is inadequate to its absorbing and propelling function.

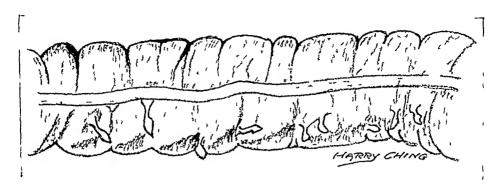
In approaching the consideration of stasis arising within the colon exclusive of neoplasms, adhesions or cicatricial narrowings, our notions may serve us better if we briefly include the anatomy of this viscus. I have in mind its individual sacculations. The longitudinal muscular fibres of the colon, instead of making up a continuous layer around the gut, have, as is known, been arranged into three distinct bands (tania coli), and being shorter from end to end than the total length of the gut, form in the arrangement of their attachments the foldings which hold the intermediate saccules (Fig. 1). When these bands are divided, the colon assumes a uniformly cylindrical form and becomes extended to its full length. Our observations during our experiments brought us to the conclusion that these sacculations are as essential to the motility as they are to the function of absorption (Fig. 2)

Our first experiments on animals proved quite disappointing Obliteration of the saccules by forceful stretching was always followed by a fatal peritonitis, and while marked stasis was presently established the infection which also followed the experiment prevented the drawing of correct conclusions as to the part actually played by the destruction of the saccules alone

When partial obliteration of the saccules was induced by gentle manipulations of the longitudinal bands, peritonitis did not ensue, and here we drew the conclusion that to whatever extent the stretching of the longitudinal bands approached annihilation of the saccules, stasis of the colon, to a proportionate degree, will result

In a series of seventy-five skiagraphs taken by Dr J Phillip Tamiesie, of the Portland Diagnostic Laboratory, it was demonstrated that individuals with long, flat and slender abdomens gave pictures of apparent visceroptosis. Yet not one of this group had suffered from constipation, although the transverse colon of some draped well into the pelvis. In all of these cases, well marked sacculations were observed in convincing contrast to those of a second series where, with histories of chronic constipation, or colonic stasis if you like, the saccules were but illy definable

In following up this work, we brought ourselves to believing it would be



FIC I -The appearance of the normal colon at rest

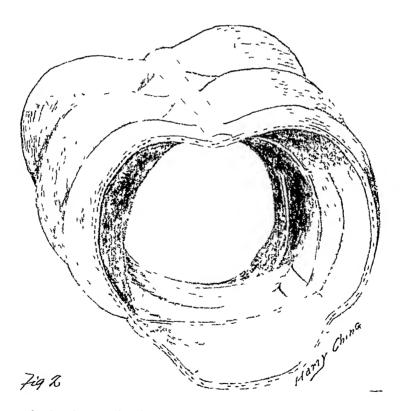
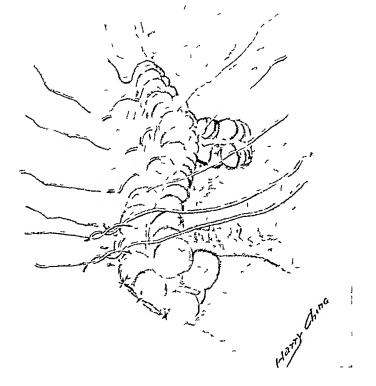


Fig 2—Segment of colon showing the characteristic features of its structure saccules and a scheme of motility is immediately presented (Testut)



 $F_{1G}$  3 —Coffey's method of reducing and fixing mobile cacum and ascending colon in place Note the well defined saccules

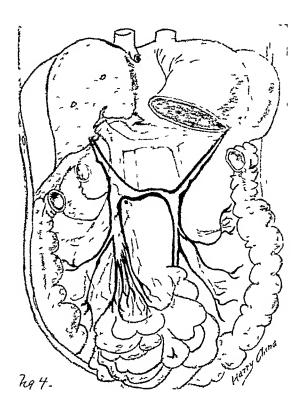


Fig. 4 —Semidiagrammatic illustration of the drag on the superior mesenteric vein on the portal vein and the inferior mesenteric vein on the splenic vein resulting from enteroptosis (K A J Mackenzie The Role of the Movable Kidney in Intestinal and Vascular Stasis)

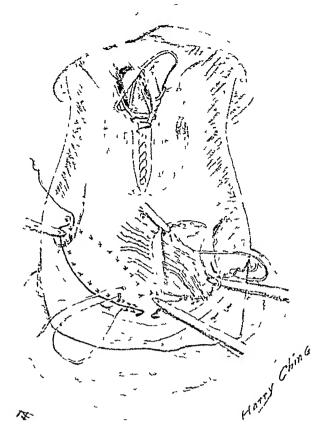


Fig 5 -Coffey's method of widening the upper and narrowing the lower abdomen

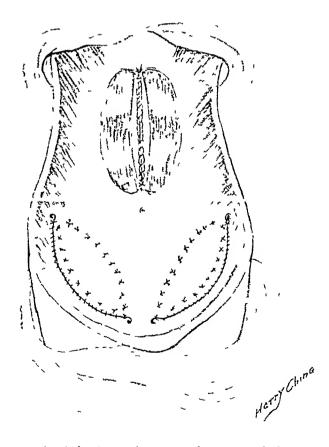


Fig. 6 —The operation completed of widening the upper and narrowing the lower abdomen as proposed by Coffev (semidiagrammatic)

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reasonably safe to exclude colonic stasis, per se, when the saccules are intact A case in point where gastrojejunostomy and later a Lane ileosigmoidostomy had failed to relieve, and notwithstanding ptosis of the transverse colon, from the well-marked saccules, it was argued that the point of stagnation was higher, as indeed operation for the third time proved. A Meckel's diverticulum adherent to the posterior parietal peritoneum had, by a drag on the ileum, narrowed its lumen into a considerable degree of obstruction

There is another cause of colonic stasis. It is one that seems to be frequently overlooked. The colon without anchorage or the so-called cacum mobile. Coffey, in his exhaustive treatise, "The Principles Underlying the Surgical Treatment of Gastro-intestinal Stasis." (Surgery, Gynacology and Obstetrics, October, 1912), shows this anomaly to be the result of an incomplete rotation and fusion of the ascending colon into place.

His original method of suturing such coli (Fig 3) gives very satisfactory results, providing no harm has been imposed upon the sacculated arrangement, in which case we incline to the teaching of J Rilus Eastman by anastomosing the head of the free caput coli to the sigmoid. The actual cures which Eastman's coliosigmoidostomy brought to six of our cæcum mobile cases prompted us to substitute this procedure for the ileosigmoidostomy of Lane when having to deal with other forms of colonic stasis. By dividing the peritoneal fastenings externally, or directly opposite the blood supply, the normally fixed ascending colon is readily mobilized and transposed inward and downward to effect the anastomosis

From a number of Lane "short circuits," the records of which were furnished by several suigeons who had had experience in performing this operation, we were induced to conclude that the improvement which follows is not an enduring one. Transplanting the ileum without bringing with it the ileocæcal valve permits of a regurgitation which sooner or later will bring about a divulsion of its scanty musculature and thereby produce the very thing the original operation was hoped to cure

The principle promulgated by Mr Lane, however, will endure because it is good and sound, and if his earlier work had been better understood fewer criticisms would have been directed against this very valuable and instructive procedure. The key-note of this principle may be struck in nine words—
i.e., never short-cricuit the colon unless it is stagnant!—and once we catch the trick of recognizing the dividing lines between stasis, ptosis and inertia of the intestinal tract, no puzzle will confront us when determining whether or not a short-circuiting operation should be performed

Indeed, is it not the very same principle with which we deal when we short-circuit the stomach into the jejunum in the presence of a gastric stasis resulting from a pyloric obstruction? It is when the entire musculature of the bowel is inert that we must become impressed with the uselessness of surgery, for with no segment more inert than the others, no point exists around which a short-circuit can relieve the stagnation, for it is a general one

With low peptic ulcer, pyloric ulcer or stenosis, duodenal ulcer or its

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sequela, cicatricial narrowing, gastrojejunostomy restores the function, but with gastric stasis because of an atony or inertia, the same operation is useless

In discussing Lane's ileosigmoidostomy, I heard Dr J B Murphy make this remark "When this bugaboo, ptosis, is eliminated from discussions on intestinal stasis, we will realize that Mr Lane deals only with facts!"

When, in 1915, I was honored with the presidency of that year's midsummer meeting, great interest attached to the meeting because of the men secured to discuss this very topic. On one point there was a general agreement. Consentaneously it was expressed that too many Lane short-circuits were being performed by men who had evidently failed to recognize the principle that was at stake. Professor Kenneth A. J. MacKenzie was of the opinion that too many were attempting surgery through the lure of mechanics, for at his clinic he had, several times, found it necessary to undo ileosigmoidostomies that had been performed with an apparent disregard for the principle involved. He spoke of it as his "unscrambling" operation

Dr A E Rockey, reporting several short-circuiting operations from which he had obtained the very best results, gave as the means of his success a strict observance of the rule laid down by the author of the procedure, to wit, "Unless you are thoroughly satisfied that the cause of the stasis lies between the caput coli and the sigmoid, do not perform any short-circuiting operation"

From a number of experiments carried on in the laboratory of the Medical Department of the University of Oregon under the direction of Professor K A J MacKenzie and which were referred to in his excellent paper, "The Rôle of the Movable Kidney in Intestinal and Vascular Stasis," he gave as his conclusion that, "As long as the intestinal lumen is preserved in its integrity, splanchnoptosis, even when far advanced, will not cause stasis, and that normal and even abnormal flexures of the intestines under like conditions, its lumen being intact, will not tend to the delay of the fecal current and cause stasis"

One interesting and striking feature of his work was seen in his original scheme of demonstrating how visceroptosis produces a venous stasis within the mesentery and which in turn strangulates the flow of chyle into the thoracic duct, gradually bringing on a degree of starvation, eventually recognized in the disappearance of the normal fat deposits of the body

Early in my own work, I reported before the Mississippi Valley Medical Society three cases of intestinal stasis caused by an inflammatory narrowing of the ileocæcal opening. These three cases I had relieved by inserting a McGraw rubber ligature through the upper angle of the junction of the ileum and the colon, then burying the work beneath a double row of Lembert's sutures.

Within the year which followed each of these operations, the stasis recurred with all of its original obstinacy. In one that submitted to a second operation, it was assumed that the return of the stasis was depending on an extreme dilatation which had occurred over several feet of the lower

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ileum This lesson impressed us greatly with the importance of the function of the ileocæcal valve Visceroptosis, of itself, is never an initial lesion, and because a skiagraph happens to show a dip that had been denied our previous notion as to just how the viscera should appear is a poor excuse for our proclaiming "ptosis!" This eiror has been a common one Indeed, it was this very error my former teacher, Doctor Muiphy, had in mind when he spoke of visceroptosis as a bugbear in discussions on intestinal stasis

Visceroptosis with a pathology has a history that is not confusing. It is the history of a prolonged overstretching of the wall of the lower abdomen Inevitably pot-belly must follow, and then comes the first cause of the drag upon the mesentery which must continue in obeying the laws of gravity until veins and lacteals become included to the degree of strangulation and, as demonstrated by MacKenzie (Fig. 4), leads insidiously to that unavoidable starvation that is characterized by the disappearance of the body's fat

These are the very cases for the correction of which Coffey devised his unique operation of narrowing the lower and widening the upper abdomen (Figs 5 and 6), and, as practised at his hospital, they represent the class of cases where the combined methods of rest in bed, forced feeding and, lastly, surgery produce the greatest good Elevating the foot of the bed enough to induce the viscera to gravitate toward former relations relieves the pull on the mesentery, and once the drag is relieved, the portal and chylic circulation becomes adequate to the needs of a readjustment of the physiology of digestion together with the proper assimilation of its products

## OBLITERATION OF THE COMMON BILE-DUCT FOLLOWING OPERATION

BY MOSES BEHREND, M D

OF PHILADELPHIA

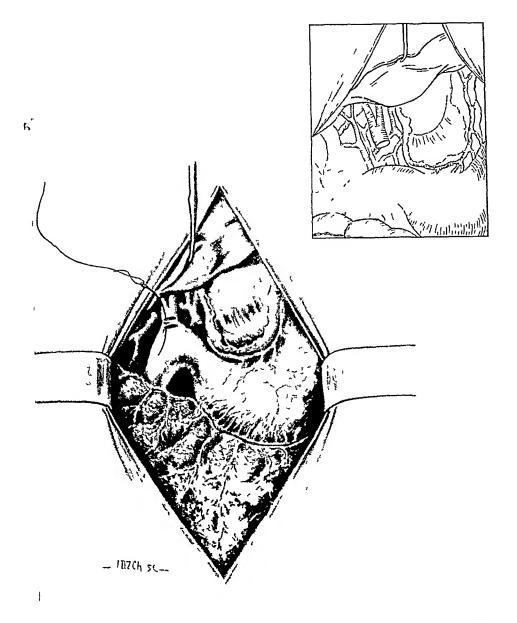
Less than fifty cases have now been reported of injury to the common bile-duct during the operation of cholecystectomy. The duct is in all probability injured quite often, but the cases are usually not reported by the operator who has had the misfortune of inflicting traumatism to the duct. The case that the author operated upon was primarily performed by a master surgeon. This bears out the statement made by a recent writer that even the most competent operators have transgressed on this important structure.

Apropos of the consideration of this subject the best method of performing a cholecystectomy must be considered. Major Seelig recently advocated the removal of the gall-bladder from above downwards. This method has its place but it is limited to much distended gall-bladders where we do not wish to aspirate its contents first. The great objection to performing the "retrograde" operation as compared to the popular operation is the annoying oozing from the liver surface which masks the field of operation.

The logical method whenever possible, and this can be done in the majority of cases, is to attack the blood supply first at the cystic duct. This is usually easily performed with the proper exposure of the cystic duct and artery. Individual hamostats are placed on these structures. To attack the blood supply at its source is the best procedure in any operation. This is exemplified in the Rodman operation for removal of the breast, in goitre operations, in operations for the removal of the tongue, in hysterectomies, gastrectomies and a host of other operations.

The patient, whose operations we are about to discuss, was admitted to the Jewish Hospital June 16, 1916 She was intensely jaundiced and complained of uncontrollable, intense itching, especially at night Some pain and tenderness were present in the right hypochondriac region A year ago she was operated on in another hospital for gall-stones. She was drained for three months after a cholecystectomy, following which she felt well for two months. She then developed chills and fever, vomiting and jaundice. Appetite became poor, the stools were continually clay colored. She lost sixty pounds in weight since her operation a year ago.

Her previous history shows that she has never been sick before the first operation. Aside from her eight pregnancies, she has never been in bed for any sickness. Her family history is unimportant "Prior to the first operation she complained of pain in the right hypochondriac region for four years. On two occasions she had chills. She was never



 $\textbf{Fig} \quad \textbf{1} \longrightarrow \textbf{Showing an astomosis of duodenum to hepatic duct} \quad A \quad \textbf{destruction of common duct following a cholecy steetomy}$ 

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jaundiced, but her skin was sallow At operation the gall-bladder was adherent, caused by many adhesions. The common duct was probed and found patulous. This is important in the light of the findings of the second operation. The gall-bladder and appendix were removed."

In the case reported after making the usual incision to the right of the median line the common duct could not be found. With a hypodermic syringe, bile was located high up under the liver in the region of the hepatic duct. This portion of the duct was greatly dilated. Upon opening the place where the needle discovered bile, we were unable to pass a probe downwards, but it passed easily in an upward direction. On account of the destruction of the common duct it was decided to anastomose the hepatic duct to the duodenum. While the common duct could have been reconstructed it was thought that a hepaticoduodenostomy would give a better result with less chance of leakage. This was accomplished with difficulty on account of the high position of the hepatic duct under the liver. The technic as followed in a gastio-enterostomy was used here with the exception that a rubber drainage tube was placed in the anastomotic opening.

Following the operation, the patient remained jaundiced for some time and the itching continued for weeks, even after her discharge from the hospital on September 3, 1916 Clay-colored stools continued until the eleventh day after operation, when the first brown stool was passed On the twelfth day, the first yellow stool was seen and this continued ever since

Notwithstanding the character of the stools, which indicated that bile must be flowing through the anastomotic opening, the patient remained jaundiced, the intense itching continued, which, however, proved later to be a habit as a result primarily of a pathological condition. On the twenty-first day a second operation was performed. After separating and dividing adhesions the site of the anastomosis was reached and seemed to be in perfect condition. The anastomosis was tested with an hypodermic syringe to note the presence or absence of bile. After confirming its presence a T-tube was inserted to insure its patulousness. Following this procedure quantities of bile and duodenal contents were drained away. The T-tube was removed in ten days. Fifteen days after the second operation the patient had a chill coincident with vomiting. After this her convalescence was uneventful. In the past year the patient has gained over fifty pounds and appears to be in the best of health.

In conclusion, the possibility of injury to the common duct must always be borne in mind, especially since this accident has happened to surgeons of unquestioned ability and large experience while doing a cholecystectomy

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# CLONORCHIS SINENSIS INFECTION OF THE GALL-BLADDER AND BILIARY PASSAGES<sup>5</sup>

## By Fred C Watson, M D of Lexington, Tenn

THERE are several species of liver fluke which may infect the gall-bladder and biliary passages of man, but only two are considered of much importance, the Clonorchis smensis and the Clonorchis endemicus They are so similar that for a long time they were generally thought to be the same parasite

History and Geographical Distribution -Clonorchis sinensis was discovered almost simultaneously by MacConnell, in India, and MacGregor, in Mauritius, in 1874 In each instance the parasite was found at necropsy in the liver of a Chinese patient who had died of an obscure liver disease It is widely distributed throughout the Orient and is particularly common in China and Japan In certain districts of the latter country, Katsurada is generally quoted as having found the ova in the fæces in from 56 to 67 per cent of the population Park, in 1890, first discovered this parasite in the United States, during an autopsy on a Chinaman Numerous cases have been reported since Gunn, in a comparatively recent article, draws our attention to its prevalence in the United States and emphasizes the danger to the public health resulting from its importation. This writer examined 604 Chinese on their arrival at San Francisco and found 125, or about 20 per cent, infected Eighty-two sick Chinese, residents of California, were examined, and the infection demonstrated in over 29 per cent Thirty-two sick Japanese, likewise residents of California, were examined, and four found infected The infection has also been reported from Canada Querens has quite recently described a case from Cuba As far as we have been able to determine our case is the first to be described from Panama

Description of Parasite—"Clonorchis sinensis measures from 10 to 20 mm in breadth, it is oblong, narrow, flat and somewhat pointed anteriorly, reddish in color, and nearly transparent (Fig 1) The oral sucker is larger than the ventral acetabulum, which is situated almost on the border between the first and second fourths of the body. The cuticle has no spines. The pharynx is globular and short, the esophagus is slender and 0.17 mm long. The bifurcation of the intestine is nearer to the oral than to the ventral sucker. The intestinal cæca are simple, slender, and extend almost to the posterior end of the body. The genital pore opens on the middle line immediately in front of the acetabulum. The testes are branched and situated in the posterior portion of the body, one behind the other. The ovary is trilobate and anterior to the testes. The uterus is moderately developed, and

<sup>\*</sup>Read at the One Hundred and Thirty-eighth Meeting of the Medical Association of the Isthmian Canal Zone, October 19, 1917



Fig i —Clonorchis sinensis

its coils are anterior to the genital glands. The vitellaria are moderately developed and occupy about the middle third of the body. The eggs are 28 to  $30\mu$  in length by 15 to  $17\mu$  in breadth, operculated, almost black in color, and contain a ciliated embryo" (Manson)

Occasionally the embryo may be seen escaping from the egg through the little lid at the top, after the escape of the embryo the lid may remain raised or become detached from the egg

Mode of Infection —Infection probably occurs through the alimentary tract by means of contaminated food or drink. The life history of the human flukes has not been definitely established, but it is thought that certain species of water-snails and fresh-water fish act as intermediate hosts. The custom of eating raw fish in Japan probably accounts for the prevalence of the infection in that country, while in China the almost universal habit of using human excreta as a fertilizer for vegetables is probably largely responsible for its prevalence there

Pathogenesis — Opinion differs as to the pathogenicity of Clonorchis sinensis. According to Stitt, many physicians in China attribute little if any pathogenic importance to it. Many observers, however, claim that its entrance into the body is followed by certain changes which nearly always prove fatal. These changes are referable chiefly to the gall-bladder and biliary passages, the parasite gaining entrance to these structures either by direct penetration of the bile-ducts or by way of the portal circulation. The gall-bladder and its ducts may be inflamed, uniformly dilated and thickened. Diverticulation of the ducts may occur, the pockets reaching the size of a filbert and containing many parasites. The parasites may completely occlude the ducts and cause retention and absorption of bile Cirrhosis may occur.

Symptomatology — There are no characteristic symptoms course of the disease is, as a rule, chronic, existing for months or years before the general health becomes markedly impaired. Irregular pains, severe at times, may be felt in the epigastiic and right hypochondriac regions Nausea and vomiting usually precede or accompany the pains varying in degree is quite constant and is recurrent The liver is generally enlarged and tender, the enlargement and tenderness being more pronounced during the attacks of jaundice and pain The spleen may be enlarged Fever may be present The appetite is variable The bowels are at first In advanced cases dysenteric symptoms develop and lead to Cachexia, œdema of the legs and ascites are also exhaustion and death The blood changes are not characteristic noted in late cases eosmophilia has been noted in the reported cases Likewise a moderate reduction in the red blood-cells and hæmoglobin

Diagnosis — The diagnosis is made by finding the characteristic ova in the fæces The infection should be suspected in all Orientals presenting vague and indefinite gastric and hepatic symptoms and a careful microscopical examination of the fæces made

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Prognosis—The prognosis is unfavorable as a rule Recovery may sometimes follow the evacuation of bloody slimy stools containing large numbers of the parasites

Treatment—The prophylaxis of this infection is very important. All measures usually recommended for the prophylaxis of intestinal parasites in general should be rigidly observed in all localities where Clonorchis sinensis is known to exist. Fresh-water fish and mollusks should not be eaten unless thoroughly cooked. To prevent its further importation into the United States, a microscopical examination of the fæces of all Orientals seeking admission should be made and if the infection is demonstrated they should not be allowed to remain. The treatment is very unsatisfactory Male fern and other well-known anthelmintics are of little if any value. Salol has a reputed value in the analogous liver fluke disease of sheep and may be beneficial in this condition. It should certainly be given a trial If the biliary ducts are occluded by the parasites producing cholangeitis and pericholangeitis, operative drainage of the biliary system should be instituted, but the relief afforded may be only temporary

In twenty-four to forty-eight hours after operation, anthelmintics may with safety be administered through the drainage tube, as was done in our case

Report of Case—The following case occurred during the writer's recent service with the United Fruit Company at Bocas del Torro, Republic of Panama Akee Lee (case history No 9247), male, Chinese, merchant, aged forty-three years, a resident of Panama for the last twenty years Was first seen on February 21, 1917, in consultation with Drs Paul Osterhout and I W McLean, when the following symptoms were noted Sharp, lancinating pains in the epigastric and right hypochondriac regions with radiation to the right shoulder blade There was nausea and vomiting and considerable prostration Examination revealed marked tenderness over the upper abdomen, particularly over the gall-bladder region There was moderate enlargement and tenderness of the liver Considerable jaundice was present The temperature was 99° F, pulse, 120, respiration, 26 Å blood count showed 15,000 leucocytes, polymorphonuclears, 82 per cent, S L, 8 per cent, L L, 4 per cent, eosinophiles, 5 per cent, transitionals, I per cent The urine contained bile The stools were light brown in color A history of similar attacks during the past three years was elicited The attacks usually come on every two or three months and last for about two weeks Jaundice is always present and gradually disappears upon the subsidence of the pains. In the intervals between attacks there is general malaise and disinclination for work He was admitted to the hospital for operation, but as improvement began, this was refused On March 13, 1917, a typical attack of jaundice and pains returned, patient was re-admitted to the hospital and operation performed the next day

Operation - Ether anæsthesia Bevan incision There were a few

adhesions about the gall-bladder and adjacent viscera. Upon separating these the gall-bladder was found to be very much thickened, somewhat inflamed and quite tense. On aspiration a watery, slightly bile-tinged fluid was obtained. This had a peculiar sickening odor and contained numerous small bits of black material which upon microscopical examination proved to be the ova of Clonorchis sinensis and mucus. Five small stones were removed from the gall-bladder. There was considerable thickening of the cystic, hepatic and common ducts which at the time we were unable to account for. There were no stones in the ducts. As prolonged drainage seemed desirable a rubber tube was sewed to the walls of the gall-bladder, no attempt being made to secure inversion of the peritoneal coat.

Postoperative Course — The drainage for the first few days was rather profuse and contained numerous small, dark plugs which were quite offensive These consisted almost entirely of ova One embryo about two-thirds grown was recovered on the second day. On the third day, the patient was turned on the abdomen for a few minutes in order to empty the gall-bladder Fifteen cubic centimetres of pelletierine (Tanret) were then introduced directly into the gallbladder through a small glass funnel attached to the rubber dramage A clamp was then placed on the tube and the medicine allowed remain for one hour One adult worm was recovered as soon as the clamp was removed and two the next day The same sized dose of pelletierine was given by mouth, followed one hour later by an ounce and a half of castor oil The stools and drainage material contained many eggs but no worms On the sixth day, 45 minims each of glycerine and the oleoresin of male fern were given by gall-bladder and the same sized dose by mouth One hour later, castor oil one and a half ounces was given by mouth No worms were recovered On the ninth day one adult worm was found in the drainage from the gall-bladder patient was discharged from the hospital April 2, 1917 The operative sinus closed nineteen days later

After leaving the hospital the patient showed gradual improvement This, however, was only temporary. On June 4, 1917, he developed an attack of jaundice and pains and was re-admitted to the hospital. His temperature at this time was 102° F, pulse, 128, respirations, 24. The stools contained a few ova. Salol 10 grains tild was given. The temperature reached normal two days later, but slight pains and jaundice were still present. Diarsenol 04 gramme was then given intravenously Improvement followed. Two weeks later patient sailed for China. For this reason we are unable to state his present condition.

In conclusion I wish to thank Col F F Russell and Dr H C Clark, of the Board of Health Laboratory, Ancon, Canal Zone, for their assistance in the identification of the parasite, Mr H L Dunn, for making the photomicrograph, and Dr W E Deeks, General Superintendent, Medical Department, United Fruit Company, New York, for permission to publish the paper

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No 5

### A CONTRIBUTION TO THE KNOWLEDGE OF FUSED KIDNEYS

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Abnormalities in the number and position of the kidneys have been noted since ages. Aristoteles mentioned a unilateral kidney defect. Malformations of the kidneys are relatively frequent and there is present in the literature of the past one hundred years a large number of observations of kidney anomalies with and without fusion. It is, however, the purpose of the writers to limit and confine their observations solely to fused kdneys

There is no distinction or attempt at classification of the various types of fusion as they are included under the general heading of fused kidneys. The terms, sigmoid kidney, dumb-bell kidney, disc-shaped kidney, etc., are of common occurrence in the literature. They merely represent various types of fusion and depend essentially upon the site and size of the connecting mass or isthmus between the two kidney masses. The several types of fused kidney represent various grades of the same process. These will be more fully considered in the discussion of the embryology of this anomaly. The type of fused kidney most commonly found is the so-called horseshoe kidney.

The horseshoe type of fused kidney includes every abnormal kidney formation wherein both kidneys are united by a large or small bridge of tissue either fibrous or parenchymatous. This fusion is usually in the region of the lower poles and along the medial surface, rarely in the region of the upper poles.

There are frequent reports in the literature of the occurrence of fused kidneys. The range of variation in the frequency of the occurrence of this anomaly, as reported by different authorities, is as follows.

Roth in 1630 sections found 5 fused or horseshoe kidneys, in this series there were 832 males (2 cases) and 798 females (3 cases). Morris in the observation of 18,244 sections found the anomaly 19 times. Balowitz in 617 sections observed it 3 times, Prendelsberger in 1344 sections, 6 times. Among 6200 autopsies performed at the Pathologic Institute at Berlin, from 1897 to 1900, this anomaly was found 6 times. Social observed 5 cases in 1630 autopsies. Nauman in 10,177 sections at Kiel, between the years 1873–1888, found 100 cases of congenital anomalies of the kidneys, horseshoe or fused kidney was present in 18 per cent of the cases observed. The

cm, distance between ureters at the lowest calyx is 8 cm, distance between middle of each pelvis 4 cm, and the distance between the mesial border of the upper poles of the kidney 6 cm. The greatest distance between two lidney masses is 10 cm and is opposite the intervertebral disc between second and third lumbar. The most caudal limit of the fused kidney is 6 cm cephalic to superior margin of the sacrum, 1 cm caudal to the line drawn through the highest point of the crest of the ilium, and 9 cm cephalic to a line drawn through the anterior superior spines of the ilia.

Blood-vessels—There are three renal arteries to the right kidney mass. The most cephalic is a branch of the abdominal aorta and arises immediately caudal to the superior mesenteric artery. This renal artery gives off two small branches to the suprarenal gland, passes dorsal to the postcava and divides into three branches which redivide into eight smaller rami as they enter the upper pole of the kidney. The second renal artery is of the same calibre as the first, coursing dorsal to a large renal vein and ventral to the postcava. The third renal is a branch of the left common iliac and is of fairly large calibre. At the caudal border of the isthmus, it divides into three rami, the middle branch being distributed to the isthmus and the two lateral rami to the right and left kidney masses. The left kidney has but one renal artery. It is a vessel of large size arising from the abdominal aorta, dividing into three large branches. The most cephalic branch enters the upper pole of the kidney, the two caudal branches, one ventral and the other dorsal to the pelvis, sweep around the hilum of the kidney and form a visible anastomosis at the lower pole.

Veins Four renal veins emerge from the right hilus and enter the postcava. The largest vein is most caudal and emerges from the hilus, dorsal to the pelvis of the ureter and ventral to the renal artery. The other three renal veins are cephalic and ventral to the renal arteries. There is but one large renal vein on the left side. This vessel emerges from the hilus, ventral to the artery, passes over the abdominal aorta and enters the postcava at an angle of 30 degrees. It is covered in its course by the superior mesenteric artery. The left spermatic vein does not empty into the renal vein proper, but enters its most caudal branch. There is also a large renal vein draining and emerging from the isthmus. This vessel is situated 3 cm to the left of the median line ventral to the renal artery (which is distributed to the lower pole of the left kidney mass), and takes a course directly caudocephalic over the ventral surface of the postcava for a distance of 4 cm to enter the median line of the postcava i cm below the left renal vein

Relations The inferior mesenteric artery courses ventral to the isthmus, 15 cm to the left of the median line, and forms a distinct groove at the point of junction between the isthmus and the left renal mass. The inferior mesenteric artery does not give any branches to the fused kidney and is unusually small in calibre

Case II —This specimen (Fig 3) is that of an adult male cadaver and is described in situ. It consists of two lateral kidney masses with a small apparently fibrous transverse connecting band, caudally placed, i.e., with the concavity cephalic

Right Kidney Mass—The right kidney mass closely approximates in shape a normal kidney. The dorsal surface is smooth and slightly concave, while the ventral surface is hollowed out along its medial portion for the hilum. The ring of kidney substance surrounding the hilus varies from 4 to 5 cm. The kidney substance lateral to the hilum is round and thick

Measurements The right kidney mass is obliquely placed, pointing caudally and medially. The greatest caudocephalic (vertical) diameter is at the lateral margin of the hilus and measures 9 cm, its greatest transverse diameter measures 7 cm and is situated about the middle of the kidney, its greatest thickness is 1 cm from the lateral margin of the hilum and measures 3.25 cm. The thickness of the entire kidney varies but slightly

Relations The upper pole is at the level of the middle of the first lumbar and the lower pole at the level of the middle of the fourth lumbar. The midline of the

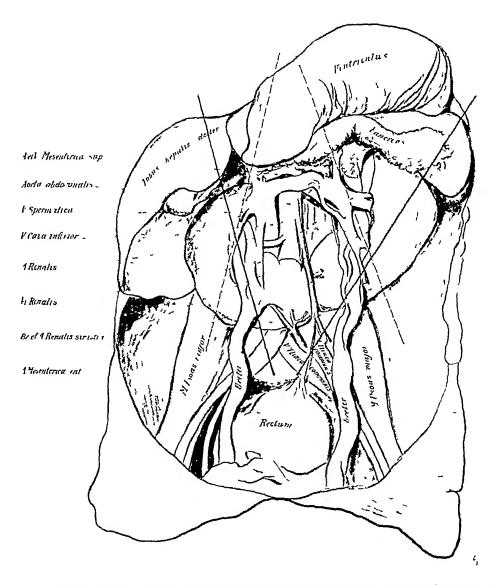


Fig. 1—Horseshoe kidney with a well marked parenchy matous bridge, for detailed description refer to text. Case I. The solid black lines drawn through the vertical (caudocephalic) diameter of each kidney mass represent the plane of the vertical diameter of fused kidneys, and are directed caudally and medially to the median line. The dotted lines which are directed cephalically and medially represent the plane of the vertical (caudocephalic) diameter of the normal kidney.

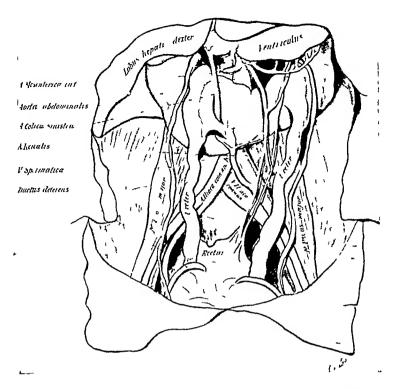


Fig 2 -Horseshoe kidney with a well marked isthmus For detailed description refer to text Case I

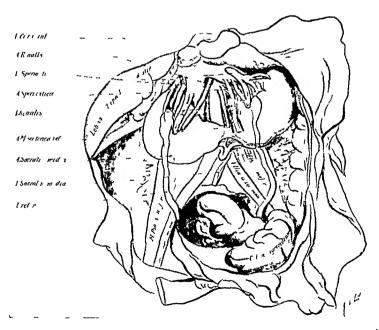
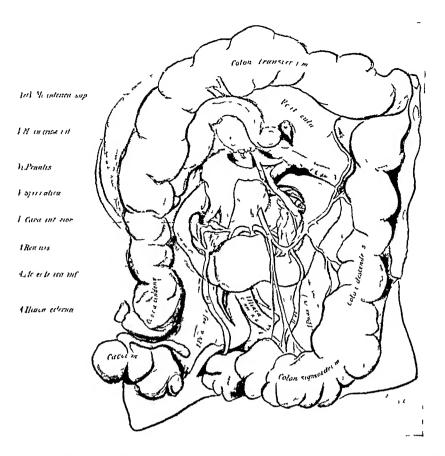
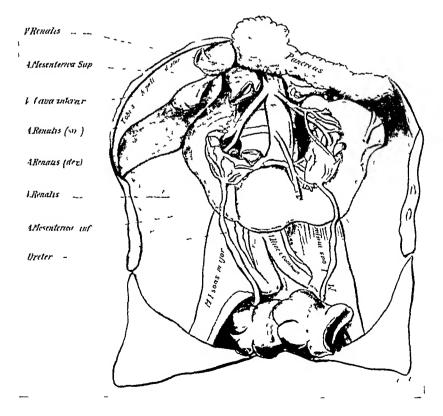


Fig 3 —Horseshoe kidney with small apparently fibrous isthmus For detailed description refer to text



 $F_{IG} \quad \text{$4$ $-$Horseshoe kidney with well marked parenchy matous is thmus} \qquad For detailed description refer to text. Case III$ 



 $F_{IG}$  5 —Horseshoe kidney with well marked parenchymatous isthmus For detiiled description refer to text. Case III



Γισ 6 —Corrosion specimen of the pelvis of a horseshoe kidney prepared by Professor Hyrtl and photo graphed by courtesy of the College of Physicians Philadelphia Mutter Museum

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hilus is opposite the intervertebral disc between the second and third lumbar vertebræ

Left Kidney Mass—The left kidney mass is larger than the right—Its dorsal

Left Kidney Mass—The left kidney mass is larger than the right its dorsal surface is smooth and its ventral surface is hollowed out along the medial border for the hilus. The kidney is normal in shape, large and well developed

Measurements The width of the pelvis varies from 35 to 45 cm. The thickness of the kidney varies from 15 to 4 cm and is greatest 2 cm below the upper pole. The greatest caudocephalic length is 10 cm, and is along the lateral border of the hilus

The cephalic limit of the upper pole is between the intervertebral disc of the first lumbar and twelfth thoracic vertebra, and rests laterally on the twelfth rib. The lower pole is at the level of the middle of the fourth lumbar vertebra, and the midline of the hilus opposite the second lumbar. The dorsal surface of the lower pole and hilus of the left kidney rest on the postcava

Isthmus—The isthmus consists apparently of a fibrous band between the kidney masses. The cephalic and caudal borders are thinned out to a sharp edge and fuse with the lower poles of each kidney mass. It arches over the abdominal aorta and is directly transverse with a slight cephalic trend toward the left due to the higher position of the left kidney. The isthmus measures 3 cm in its transverse diameter and 125 cm in its vertical diameter.

Relations The isthmus crosses the midline of the body of the third lumbar vertebra, passes over the abdominal aorta and joins the right kidney mass 5 cm from the right lateral margin of the aorta and the left kidney mass 5 cm from the left margin of the aorta

Uteters—The pelvis of the right ureter is normal in size. The ureter cephalic to the bifurcation of the common iliac is slightly dilated. The length of the ureter measured from the lowest calyx to its entrance in the bladder is 21 cm. The right ureter crosses the common iliac artery immediately cephalic to its bifurcation. The pelvis of the right ureter divides into five calyces which are arranged in two rows, four in the ventral and one in the dorsal. The pelvis of the left ureter is normal in size. The ureter presents a fusiform dilatation in its pelvic portion and crosses the common iliac just above its bifurcation. The length of the left ureter is 23 cm. The pelvis of the left ureter divides into four ventral calyces and one dorsal.

Measurements The distance between the lower poles of the kidney masses is 10 cm and between the upper poles 12 cm. The ureter and the pelvis of each kidney mass are ventral to the kidney substance and caudal to the renal vessels. The most caudal limit of the fused kidney is 2 cm. cephalic to a line drawn through the highest points of the crest of the ilium. The most caudal limit of the isthmus in the median line is 10 cm. distant from the superior margin of the sacrum, the most caudal limit of the left kidney is 9 cm. and the most caudal limit of the right kidney 8 cm. The most caudal limit of the fused kidney is 9 cm. cephalic to a line drawn through the anterior superior spines of the ilia.

Blood-vessels—The right kidney mass receives its blood supply from three renal arteries. The two cephalic arteries are vessels of large calibre arising separately from the aorta. The most caudal branch arises from the left common iliac. The most cephalic renal artery courses over the second lumbar vertebra dorsal to the postcava and divides into three branches which enter the superior margin of the hilum. The most caudal branch sweeps around the lateral edge of the hilum to the lower pole and enters the kidney substance proper. The other renal artery arising from the aorta, courses in a caudolateral direction and breaks up into four branches before entering the hilum. The most caudal renal artery is the largest and enters at the caudal and median border of the right kidney mass, the latter vessel passes ventral to the postcava. The arteries are dorsal to the corresponding renal veins.

There is only one large renal artery to the left kidney mass. This vessel is larger in calibre than a normal renal artery. It arises as a separate branch directly from the aorta, at a higher level than the renal artery of the right side, courses

cephalic and ventral to the renal vein and breaks up into two main trunks which redivide into six smaller rami before entering the hilus

A large renal artery arises from the left common iliac immediately cephalic to the bifurcation of the aorta. The latter vessel courses cephalically for a distance of 2 cm over the aorta and divides into two rami. The right ramus measures 15 cm and redivides into two branches, one entering the lower pole of the right kidney, the other the isthmus. The left branch measures 2 cm and takes an obliquely cephalic course and enters the lower pole of the left kidney mass. The corresponding vein of this vessel is ventral to the artery and enters the common iliac 25 cm below the caudal limit of the artery.

Veins Three large renal veins emerge from the hilus of the right kidney, two of the latter emerge from the upper part of the hilus and the most caudal emerges from the most caudal part of the hilus. The veins are ventral to the corresponding renal arteries and enter the postcava as separate vessels

Three renal veins emerge from the left hilus, course dorsal to the renal arteries and 4 cm from the lateral border of the hilus they unite and form a single vessel. The latter vessel receives on its dorsal surface two ascending lumbar veins, one of considerable size. The renal vein on its superior aspect receives a large suprarenal vein, the latter before entering the renal receives a large renal branch from the upper pole of the kidney. The renal vein proper takes a slightly transverse course cephalic to the renal arteries, courses over the aorta and enters the postcava immediately caudal to the origin of the superior mesenteric artery.

The distance between the two ureters as they leave the hilus is 75 cm. The right pelvis divides into 5 calyces, arranged in two rows, four ventral and one dorsal. The left pelvis also divides into five calyces, four ventral and one dorsal.

Relations The inferior mesenteric artery and vein cross the isthmus at the point of fusion of the latter with the lower left pole. The left colic artery in its course to the colon crosses the caudal margin of the left kidney mass. The left spermatic artery and vein cross the medial margin of the lower pole of the left kidney. The right spermatic artery and vein pass ventral to the renal artery and vein and cross the medial part of the lower pole of the right kidney.

Case III—This specimen (Figs 4 and 5) consists of two lateral masses with an intervening isthmus. The specimen is that of an adult male cadaver and is described in situ

Right Kidney Mass—The right kidney mass is irregular, rounded and semilunar in outline. The dorsal surface is smooth and the ventral surface is hollowed out along its medial border for the hilus. The lateral border presents a rounded, angular protuberant mass of kidney substance.

Measurements The right kidney mass is obliquely placed. Its greatest caudo-cephalic diameter is 9 cm. The right kidney becomes angular along the outer border. The greatest transverse diameter is at the level of the middle of the pelvis and measures 7 cm. Its thickness varies, and is greatest immediately cephalic to the pelvis and below the upper pole, measuring 35 cm.

The hilus is formed at the expense of the ventral surface and measures 5 cm in its vertical diameter and 4 cm in its transverse

Relations The upper pole is on a level with the upper (cephalic) margin of the second lumbar vertebra and the lower pole on a level with the intervertebral disc between the third and fourth lumbar vertebræ. The middle of the hilus is opposite the intervertebral disc between the second and third lumbar.

Left Kidney Mass—Small in size and with the exception of the lower pole is almost entirely destroyed by the presence of six cysts. The upper pole is completely destroyed by one large cyst, the other cysts being situated on the ventral surface. Its greatest caudocephalic diameter is 13 cm, its greatest transverse diameter 4 cm. The thickness is difficult to determine, as the kidney with the exception of the caudal

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portion of the dorsal surface and the lower pole is in a state of cystic degeneration

Relations The upper pole is on a level with the upper border of the first lumbar vertebra, the lower pole on a level with the caudal half of the fourth lumbar vertebra. The middle of the hilus is on a level with a line drawn through the intervertebral disc between the second and third lumbar vertebræ

Isthmus—The connecting band is of a rough quadrilateral shape, joining the two lower poles of each kidney mass. The cephalic and caudal margins of the isthmus are sharp and thicken slightly at each extremity as they fuse with the kidney masses. The isthmus arches over the abdominal aorta and is almost directly transverse in its course from right to left.

Measurements The isthmus does not measure more than I cm in its greatest thickness which is along the upper border and at the site of fusion with the kidney masses. Its transverse diameter is 45 cm and its vertical diameter 4 cm. The cephalic margin is opposite the upper border of the third lumbar vertebra. It joins the right kidney mass at the right lateral border of the aorta, and the left kidney mass at the left lateral border of the aorta. The caudal margin of the isthmus is on a level with the middle of the intervertebral disc between the third and fourth lumbar vertebræ.

Ureters—The pelvis of the right ureter is dilated to twice its normal size. The right ureter proper is normal in calibre and measures 18 cm. from the lowest calyx to its entrance into the bladder. The ureter crosses the external iliac i cm. caudal to the bifurcation of the common iliac. The ureter is placed ventral to the kidney substance and its pelvis divides into two rows of calyces—one cephalic and one caudal, the cephalic redividing into five minor calyces, the caudal into four

The pelvis of the left ureter is dilated to three times its normal size. The left ureter proper is normal but slightly smaller than the right and measures 17 cm. from the lowest cally to its entrance into the bladder. The ureter is ventral to the kidney substance and blood-vessels. The point of origin of the ureter is variable, on the right side it arises from the caudal margin of the pelvis, and on the left side from the middle of the pelvis. There are two rows of calyces, one caudal and one cephalic, the cephalic redividing into two minor calyces and the caudal into four. There are a number of small stones present in the calyces of the left kidney and in the bladder. The right kidney is free from nephrolithiasis. The inferior mesenteric artery passes over the left ureter and its pelvis and gives origin to the left colic artery, the vessel passing ventral to the hilus in its course to the colon.

Blood-vessels—The right kidney mass receives its blood supply from two renal arteries. The cephalic vessel is of large calibre and takes a very oblique caudolateral course, passing dorsal to the postcava, cephalic and dorsal to the renal veins, and divides at the upper part of the hilus into its terminal branches. The caudal renal artery arises from the right lateral edge of the abdominal aorta at the cephalic margin of the isthmus. This vessel courses from left to right for a distance of 2 cm along the cephalic margin of the isthmus, enters the hilus and divides into two terminal branches. The latter vessels sweep around the hilus, one ventral and one dorsal to the pelvis, give branches to the kidney substance and isthmus and anastomose at the cephalic border of the pelvis with branches of the cephalic renal artery

It is worthy of note that the blood supply of the left kidney is very deficient. There are two renal arteries, the cephalic renal artery exceedingly small in character is a branch of the abdominal aorta, courses dorsal to the renal vein and divides into two terminal branches. The left caudal renal artery arises from the abdominal aorta lateral to the right caudal renal artery. It courses over the ventral surface of the aorta along the cephalic border of the isthmus for a distance of 25 cm and divides into three terminal branches which are distributed almost in their entirety to the lower pole and isthmus

Veins Only one large renal vein emerges from the right kidney This vessel

takes an obliquely cephalic course, ventral to the renal artery, and enters the right lateral margin of the postcava. There are no veins emerging from the isthmus. Two renal veins, one caudal and one cephalic, emerge from the hilus of the left kidney. They are both of large calibre. The caudal renal vein takes an obliquely cephalic course, ventral to the cephalic renal vein with which it unites to form a single renal vein at the left lateral margin of the aorta. The common renal vein courses over the ventral surface of the aorta and enters the left lateral border of the postcava.

Measurements The distance between the upper poles is 7 cm, and the distance between the ureters as they leave the pelvis 7 cm. A line drawn through the highest points to the crest of the ilia is 25 cm cephalic to the most caudal limit of the fused kidney. A line drawn through the anterior superior spines of the ilium is 5 cm caudal to the most caudal limit of the fused kidney. The most caudal limit of the fused kidney is 45 cm distant from the superior margin of the sacrum

#### **EMBRYOLOGY**

In the development of the kidney we have not to deal with the development of a single organ Three organs are developed in succession pronephros, mesonephros and metanephros Each new organ supplants its predecessor and the last to develop becomes the permanent kidney The permanent kidney (metanephros) is derived from two separate anlagen which unite secondarily The epithelium of the ureter, renal pelvis and collecting tubules are derived from the mesonephric duct, the convoluted tubules and glomeruli directly from the mesenchyme. The kidney during its growth migrates and undergoes a rotation around its long axis. The definitive position of the renal pelvis in the fœtus, the second lumbar vertebra, is established about the thirtieth day of intra-uterine life. The caudal and cephalic poles of the kidney are established somewhat later, and in the absence of hindrance to the ascent of the kidney, the cranial pole rises to the level of the eleventh rib and the caudal pole descends to the level of the fifth lumbar vertebra In this growth the left kidney is always in advance of the right After birth, changes in the position of the kidney also occur In children less than one year old, Alglave (1910), in one-half of the cases examined, found the caudal pole in the iliac fossa. In children between one and two years it was at the crest of the ilium (3 out of 9), and in those more than two years of age it was always above the iliac crest. This change is a passive one, depending essentially upon the stronger growth of the posterior abdominal wall Fused kidneys are situated at a lower level than normal kidneys, approaching the normal level of the kidney when the transverse bar or isthmus consists of a small fibrous band. In the fourth and fifth month of intra-uterine life a ventral lip is formed to the hilum. This ventral lip is found absent in fused kidneys The union of the kidney blastema of the right side with that of the left occurs very early Felix observed a fused kidney in an embryo of 30 mm (greatest length), or about fifty-five days, m which the isthmus was caught by the inferior mesenteric artery, Schaeffer observed a fusion of the two kidney blastemata in an embryo of approximately one hundred days Felix further states that in embryos the con-

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stituents of the two kidney blastemata in the transverse bar are sharply demarcated In adult fused kidneys with a large well-marked parenchymatous isthmus, the two kidney blastemata are, however, indefinably blended Lewis and Papez found a number of anomalies of the kidneys in hog

embryos The normal relations of the kidney were found to vary as a result of the relation of the kidneys to the bifurcation of the aorta into the two iliacs This bifurcation forms a  $\wedge$ -shaped crotch in which the kidneys are lodged and from which they escape by migrating upward The arteries as a mechanical obstruction tend to bring the right and left kidney blastemata together, so that fusion may readily take place Fusion of the upper poles usually arises earlier than fusion of the lower. This explanation of the genesis of fused kidney is most plausible, for fusion of the kidney blastemata usually occurs in the neighborhood of the bifurcation of the aorta, and fusion of the upper poles which usually occurs earlier, the isthmus is most commonly placed dorsal to the aorta

#### ANATOMICAL DISCUSSION

The pelvis of the fused kidney is deviated from that of the normal pelvis in the arrangement of the calyces and in its position ventral to the renal vessels The peculiar arrangement of the calyces of the pelvis into two rows, one ventral and one dorsal, each containing from two to five minor calyces, and the absence of the calyces major, is present in the three cases observed by the writers Corrosion specimens of the pelvis of fused kidneys reveal in relief the arrangement of the calyces into two different size rows and the absence of the calyces major (Fig 6) The pelvis and ureter are ventral to the renal vessels. The ventral lip of the hilum is absent in fused kidneys Exceptionally, the pelvis may be ventral in an otherwise normal kidney. A case of this type is described by Cords

A great number of variations are encountered in the blood-vessels vary in number, in origin and in their anatomic course and relations. In general, it may be noted that they are usually at a lower level than the normal renal arteries and are increased in number It is not infrequent in the normal kidney to encounter additional renal arteries In fused kidneys additional renal arteries are the rule rather than the exception, as many as five or six to one kidney mass have been reported, the usual number is two to three The corresponding renal veins are usually ventral to the renal arteries. The ventral surface of the kidney is normally covered by peritoneum In a pelvic kidney only a portion of the ventral surface is covered by peritoneum and the latter reflected to the bladder or rectum, producing an

excavatio vesicorenalis or rectorenalis

Gruber in 33 cases of fused kidneys found the rectum transposed to the left side eleven times. Strube and Gerster have noted the association of fused kidney with atresia of the rectum Goddard reports a case of atresia of the rectum and patency of the urachus Bosquet reports in a female

the association of a fused kidney with complete absence of the bladder. These facts have an interest in that other anomalies are frequently associated with fused kidneys. Malformations of the genital organs are, however, more frequently associated with fused kidneys than other variations. This is due to the close connection between the Mullerian and urinary ducts during the developmental stage. Ballowitz in 103 cases of renal malformations found 73 anomalies of the genital organs, Paltauff, in the observation of 79 unicornate uteri, found in 27, anomalies of the kidney, ureter and pelvis. As the majority of fused kidneys occur in males, cryptorchism is not uncommon. Anomalies of the ureter are, however, unusual, and do not occur in a greater degree of frequency than in normal kidneys, but all possible variations may occur.

The suprarenal glands, although neither functionally nor developmentally a part of the kidney, are normally anatomically in intimate relation to the superomedial aspects of the kidney The suprarenal gland reaches its adult position by the middle of the third month At birth the ratio of their weight to that of the kidneys is about I to 3, in the adult I to 28 Absence of the suprarenals, although very rare, has been described in perfectly normal subjects In such cases careful histologic search should be made in the substance of the kidney for the presence of suprarenal tissue before a declaration of agenesis is made. In passing it should be stated that Bartlett and others have found suprarenal tissue embedded in the substance of the kidney proper, forming the so-called subcapsular location of the suprarenal More commonly these defects—absence of the suprarenals or maldevelopment of them (hypoplasia)—are observed in monsters and especially in those forms in which gross defects of the brain are present. On the other hand, hydrocephalus and defects of the posterior part of the brain have no influence on the suprarenals Neusser has described a case in which a union of the two suprarenals occurred in the form of a horseshoe suprarenal In congenital displacements of the kidneys and in fused kidneys the suprarenals are almost always in their normal anatomic position

Additional details of the anatomic discussion are contained in the clinical discussion

#### CLINICAL DISCUSSION

Fused kidneys occur with sufficient frequency to be of interest to the clinician, urologist, and surgeon. The unusually high percentage of its occurrence, 72 per cent found by the writers, the large number of scattered cases reported singly and collectively in the literature, and those cases in which a fused kidney has been unexpectedly encountered during operation or found at autopsy, raise the frequency of the occurrence of this anomaly far above the usual and accepted incidence of approximately 1–700. The cases of fused kidney which have been reported singly far exceed those reported in the observation of large and extensive series as delineated in the

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introduction Botez in 1912 collected from the literature 72 cases observed in series observations and 248 cases reported singly

The kidney congenitally has a low position and may remain in any part of its course from its initial site to its normal position, at times it assumes a totally changed site. It may remain in the pelvis, at the promontory, or in the iliac fossa, and in very rare instances in the inguinal canal

Fusion of the kidneys usually occurs in the region of the lower poles and at the plane of the bifurcation of the aorta. In fusion of the upper poles the fused kidney is usually situated at a lower level in the pelvis, with the isthmus most commonly dorsal to the aorta. Fusion may also take place along part or the whole of the medial surface (dumb-bell kidney, disc kidney) or may lie above the other or vice versa.

The appearance of fused kidneys is variable. It may approach the normal kidney or be walnut-shaped, nodular or, indeed, may show lobulation (Kauffman). The isthmus may be fibrous and both kidneys retain their normal positions, or the left kidney be placed somewhat to the right. It is rare, however, to find a fused kidney at the level of the normal kidney. Not infrequently the isthmus is parenchymatous and fuses indefinably with each kidney mass. The fused kidney as stated above is usually situated at a level caudal to the normal position of the kidney, and the level at which a fused kidney lies is directly proportionate to the size of the parenchymatous bridge, i.e., the larger the isthmus the more caudal lies the kidney

There is no typical clinical picture. The symptoms and physical signs of fused kidneys depend upon its more caudal position, its mobility, pressure upon the adjacent anatomic structures or upon the presence of an accompanying diseased condition of the organ. Reflex symptoms are not uncommonly present. The greater number of cases do not produce symptoms and are only encountered accidentally during operation or found at autopsy. It must not be forgotten that in order to diagnose this anomaly it is necessary to look for it, it is necessary to have it in mind when one palpates the abdomen

The diagnosis can only be made positively in those rare instances where both lower poles can be palpated or are evident from X-ray examination Israel in one case was able to palpate clinically the entire horseshoe kidney mass. Israel and Kuttner state that gradual narrowing of the lower poles as they approach the median line of the vertebral column is suggestive of fused kidneys. The palpation of lower poles of the kidney and their connection by a transverse bar is particularly difficult if the connecting mass between the two kidneys is small. The presence of both kidneys at a level caudal to the normal position of the kidney is very suggestive of fused kidney. Both kidneys may be displaced and yet be independent, the latter, however, is very rare. Strübe found only four cases in all literature in which both kidneys were heterotopic and independent. Hence, when both kidneys are located considerably caudal to the normal location of the kidney, it almost always means a fused kidney.

The fetal kidney lies at a level caudal to that of the adult, and also more

medial and ventral in position. The plane of the greatest vertical or caudocephalic diameter of each kidney mass of a fused kidney is directed caudally and medially and forms an angle caudally with the corresponding vertical diameter of the opposite kidney mass, less frequently the vertical diameter of one or both kidney masses is parallel to the median line. The vertical or caudocephalic diameter of the normal adult kidney to the median line is directed cephalically and medially and forms an angle cephalically with the corresponding vertical diameter of the opposite kidney (Fig. 1). In horseshoe kidneys the kidney masses retain their embryonic position, the angle which the vertical or caudocephalic diameter of each kidney mass forms with the median line of the vertebral column is somewhat smaller than in embryonic kidneys (Zondek), rarely the upper pole of a fused kidney is directed medially

Luschka and Kauffmann state that in the normal kidney the medial border of the upper poles of the kidney is 25 to 5 cm distant from the median line and the medial borders of the lower pole 55 to 7 cm, Testut gives these measurements as 25 cm for the upper pole and from 35 to 5 cm for the lower poles. In the specimens of fused kidneys examined by the writers these measurements are reversed

Rumpel, Von Fritsch, Roth and Krotoszymer report operations for nephrolithiasis and make the interesting observations that the stones were situated between the second and third lumbar vertebræ

The ureters of fused kidneys are shorter than the normal ureter This may be of value in diagnosis if the length can be determined. In the fused kidneys examined by the writers the length of the ureters varied from 17 to 22 5 cm. Waldeyer states that the normal length of the ureter is 30 cm., Schwalbe gives 282 mm for the right ureter and 292 mm for the left, Altuchow gives 292 mm for the right ureter and 308 for the left.

Oehler states that hydronephrosis and pyonephrosis are the most common pathologic lesions encountered in congenital displacements of the kidney, and not infrequently nephrolithiasis. Strube states that pathologic lesions do not occur with greater frequency in fused kidneys than in normal kidneys, yet many authorities have noted the unusual predisposition of these organs to infection.

Obviously in operating on fused kidneys we must be sure of the functional integrity of the uninvolved kidney. The treatment of horseshoe kidney is in principle the same as treatment of anatomically normal diseased kidney. Oehler in his discussion of the therapeusis of fused kidneys aptly states that it is difficult in all complex surgical problems to lay down definite rules to follow, each case must be individualized. Some operators, like Israel, Socin, Zondek, Oehler, Rovsing, Mr. Leedham Green and others, and Thompson, Mayo and Harris in this country, were successful in removing the pyonephritic part of a fused kidney, the remaining part of which functionated satisfactorily afterwards. Mr. Leedham Green reports four operations on fused kidneys, twice resecting half of the organ for severe pyonephros and twice removing

#### FUSED KIDNEYS

calculi from the pelvis, all these cases did well save one of nephrolithotomy in which a carcinoma was later found

Rovsing has removed the entire half of a fused kidney for hydronephrosis, tuberculosis, tumor and nephrolithiasis In eleven cases of fused kidney at the Mayo Clinic and reported by Braasch the following conditions were found complicating this anomaly Hydronephrosis, 4, tumor (sarcoma?), 1, renal hæmaturia (essential), I, discovered in operating for other abdominal conditions and otherwise normal, 4

Martinov and Rovsing have proposed a radical treatment for undiseased horseshoe kidney when it gives rise to symptoms of sufficient importance This treatment consists of a complete division of the renal isthmus between the two lobes so that the fused kidney is transformed into two organs states that this operation may be considered as a very brilliant conception of the surgery of horseshoe kidney In cases of suspected congenital lesions of the kidneys ventral laparotomy should be the choice of operative approach

The writers wish to express their high appreciation to Professor J Parsons Schaeffer, head of the Department of Anatomy, for his ever-ready assistance, helpful criticisms and interest in this study, and to Dr John F Little for sketching the illustrations

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# SURGICAL IMPORTANCE OF SUPERNUMERARY ARTERIES TO THE KIDNEY

By DANIEL N EISENDRATH, M D of CHICAGO, ILLINOIS

A knowledge of the most frequent anomalies in the blood supply of certain viscera like the kidney or gall-bladder is indispensable at the present time. A lack of such information accounts for a relatively large percentage of the accidents both during and after operations upon the urinary or biliary tract. This is especially true of the former where supernumerary arteries arise from the aorta and iliacs and enter the upper (Fig. 1) or lower poles (Fig. 2) of the kidney of both poles independently of the main renal vessels

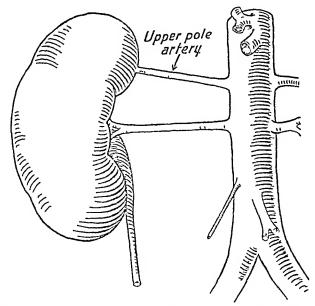


Fig 1—Artery from aorta directly to upper pole. This form is most frequently thought to be a fibrous strand or adhesion unless one remembers the possible presence of such a supernumerary artery in the mobilization of the upper pole.

I have called attention in a previous article <sup>1</sup> to the infrequent reference to these anomalies in nearly all of the books on anatomy and even of surgery of the urinary tract. In our first contribution we reported the results of the examination of 200 kidneys and found that supernumerary arteries to the upper pole occurred in nearly 4 per cent, and to the lower pole in 3 per cent. These percentages correspond very closely with the observations of Thomson <sup>2</sup> and Seldowitsch, <sup>3</sup> but are much lower than those published later by Rupert <sup>4</sup>

In the previous paper we referred to our case in which a fatal hemor-

<sup>&</sup>lt;sup>1</sup> Jour A M A, 1910, lv, 1375

<sup>&</sup>lt;sup>2</sup> Jour Anat and Phys, vol xxv

<sup>&</sup>lt;sup>8</sup> Arch klin Chir, 1909, lx\xix, 1071

<sup>&</sup>lt;sup>4</sup>Surg, Gyn and Obst, 1913, xvii, 580

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rhage occurred after nephrectomy from a torn artery to the lower pole of the kidney I have recently seen such an almost uncontrollable hemorrhage which took place during the delivery of a very adherent kidney, but in a third case was able to prevent such an accident and ligate a superior polar artery before the kidney was brought into the incision

That an accessory artery to the lower pole may cause a hydronephrosis by compression of the ureter has been clearly shown by Ekehorn and W J Mayo I have recently published a typical case of this kind (Fig. 3)

In order to avoid tearing off or division of an accessory artery to the upper or lower pole of the kidney in cases where no hydronephrosis is present, I have adopted the following technic. As soon as the kidney is

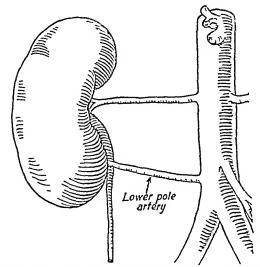


Fig 2—Artery from lower portion of aorta directly to lower pole of the kidney, a frequent cause of hydronephrosis

ready to be freed from its perinephritic bed the ureter is first ligated and then the poles are palpated to ascertain whether any firm strand of tissue enters either the upper or lower pole. As the kidney is gradually brought into the incision, the fat around the poles is carefully pushed away until we are certain that no abnormal vessels are present. In a recent case (Fig. 4) this routine method of mobilization of the upper pole enabled me to find an artery the size of the radial passing directly from the aorta to the upper pole and to ligate it before the kidney was delivered

I cannot emphasize too strongly the necessity of bearing in mind the relatively frequent occurrence of these supernumerary renal arteries

<sup>&</sup>lt;sup>5</sup> Surgical Clinics of Chicago, 1918, 1, 95



Fig. 3 —Kidney showing how an accessory artery (1) to lower pole may cause hydrorephrosis by compression of the ureter at its junction with the renal pelvis

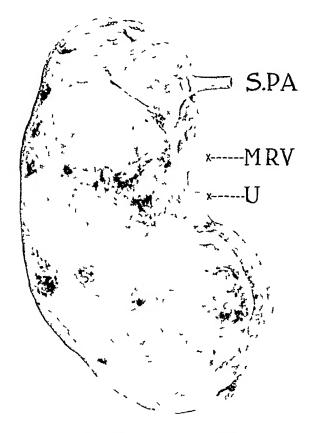


Fig. 4—Photograph of tuberculous kidnes, showing a typical superior polar afters (S.P.A.) If the ureter (U) is first divided close to the kidnes, one can more readily mobilize the upper and lower poles and look for supernumerary afteries and ligate them in situ as was done in this case. The main remail (M.R.V.) vessels are lighted as the last step of the operation

## PLASTIC (RECONSTRUCTIVE) SURGERY OF THE HAND AND THE FOREARM $^{\dagger}$

# By A BRUCE GILL, M D OF PHILADELPHIA

RECONSTRUCTIVE surgery of the hand and the forearm is of very great importance because of the large number of mechanics and workmen who suffer injury to these members and who are more or less permanently disabled thereby. Injuries of the upper extremities are much more disabling than similar injuries of the lower extremities.

It is difficult surgery because of the complex and fine structure and function of the hand. There are certain principles which must be here strictly observed, for ill-advised, poorly-planned, and improperly-executed operations will only make the patient worse. And even slight infections may destroy your finest work.

Finally, this branch of surgery has been more or less neglected by the general surgeon. It is often tedious and requires considerable patience and prolonged after-treatment. Unfortunately, repair of injuries of the hand and the forearm is frequently made by the inexperienced hospital interne in the receiving ward. The patient is afterwards dressed in the surgical dispensary. And as his wound heals he is discharged with a more or less disabled hand. He departs, taking it for granted that nothing more can be done for him. Seven of the following eleven cases had hospital treatment before they were seen by the author.

The principles of orthopædic surgery applied in the operative work and in the after-treatment by massage, electricity, hydrotherapy, active and passive movements, and by the use of special splints as necessary, will go far toward the restoration of these industrial cripples to their former positions of usefulness and independence

The following cases are presented to illustrate some of these methods of surgery and their results

Case I — E M In August, 1914, she had an infection of the right hand Sinuses remained open at the sites of incision for five weeks. The fourth and fifth fingers were left stiff in almost complete extension, while active and passive flexion were impossible. Massage was begun and continued for almost eight months with but little improvement. She was then referred to the orthopædic clinic at the Presbyterian Hospital. Examination showed that the extensor tendons of the fourth and fifth fingers were adherent on the dorsum of the hand, that the fingers were held in almost full extension, and that active and passive flexion of these fingers were greatly limited and painful

<sup>\*</sup> Read before the Philadelphia Academy of Surgery, February 7, 1918

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Operation (May 3, 1915) —Through a longitudinal incision the extensor tendons of the fourth and fifth fingers were exposed over their entire course on the dorsum of the hand. They were found firmly adherent to the skin and to the structures beneath them. The adhesions were divided with a sharp knife to cause as little injury to the tissues as possible. The fingers could then be well flexed passively. The incision was sutured. The wound healed by first intention. Ten days later massage was begun. Some improvement followed this operation, but active and passive flexion were incomplete and forced motion or active effort elicited fairly severe pain about the metacarpophalangeal joints.

Second Operation (October 5, 1915) —The tendons were freed from adhesions and were surrounded by a layer of fat taken from the thigh Improvement following this operation was rapid, and within a few months she regained complete normal motion and function of the two fingers A good result was obtained only when the tendons were surrounded by fat from the thigh

Case II—M N Seen at the Orthopædic Hospital on May 26, 1917 In August, 1916, her left hand had been cut with glass on the ulnar side of the palm An operation had been performed at another hospital in Philadelphia Examination showed a long dense scar extending longitudinally on the ulnar side of the palmar surface of the left hand The little finger was held in a position of partial flexion beyond which active and passive extension were impossible Passive flexion was complete, but active flexion was absent There was numbness over the two distal phalanges The position of the finger interfered with her work in the mill

Operation (September 7, 1917) —Incision along the old scar After considerable dissection the ends of the severed flexor tendons were found buried in scar tissue one and one-half inches apart. The finger could not be fully extended owing to contracture in the joints. Union of the separated ends of the tendons was secured by means of a bridge of fibrous tissue that was adherent to the distal ends. A piece of fat from the thigh was placed about the tendon, and the wound was closed

September 22, 1917 Wound healed, no active motion of sutured tendons

October 23, 1917 Good active motion in metacarpophalangeal joint, none in the interphalangeal joints

November 17, 1917 Moderate contracture in interphalangeal joints Slight active flexion of second and third phalanges Sharp, cutting pain in palm on motion of finger, tendons slightly adherent to scar in region of distal transverse palmar crease

February 23, 1918 On making fist the finger flexes completely into the palm, but on holding the other fingers extended the little finger does not flex completely. Active flexion in all joints. Passive extension incomplete, even when metacarpophalangeal joint is flexed. Complete return of sensation in finger.

#### PLASTIC (RECONSTRUCTIVE) SURGERY

March 30, 1918 Good active flexion in all joints Passive and active extension incomplete and identical Good function of finger, no interference with work, but patient complains of pain in distal palmar crease on flexion of the finger Advise second operation with incision along line of palmar crease to free tendons from adhesions and to place another small layer of fat from the thigh about them

Discussion —When operating on this case the mistake was made in making a longitudinal incision along the line of the old incision in the palm. A transverse incision along the distal palmar crease and then longitudinally along the ulnar side of the hand would have been better. The original longitudinal incision of the palm left a hard adherent scar a year later, and a thick firm scar is still present from the last operation. A longitudinal incision on the dorsum of the hand leaves no bad results, as illustrated in Case I, but on the palmar surface of the hand and fingers it should always be avoided if possible. The following case illustrates the advantage of a transverse incision along the line of a natural crease.

Case III—G H, a mechanic September 20, 1917, he was struck on the palmar surface of the wrist by a steel shaving. The foreman of the shop drew out a piece of steel which was protruding from the skin. The wound soon healed

October 16, 1917 Referred to my dispensary at the Presbyterian Hospital Diminished sensation present along the median nerve distribution. The nerve evidently had been injured in the wrist by the steel. Unable to make good fist. Very little power in fourth and fifth fingers in active flexion.

January 8, 1918 Almost complete return of normal sensation Only one-half normal active flexion of fourth and fifth fingers. A small firm mass felt in palm along line of their tendons. An X-1ay plate showed a long narrow piece of steel present in palm of hand

Operation (January 15, 1918) —Incision along distal palmar crease After a fairly long search the steel was found within the common sheath of the flexor tendons lying between the superficial and the deep Wound closed with three fine catgut sutures

February 7, 1918 Wound healed, scar scarcely visible Patient has returned to work Complete normal function of fingers and hand

Case IV—L S December 22, 1917 Orthopædic Hospital In September a heavy door closed on his left hand, and the ring which he was wearing on his fourth finger severed the flexor tendons of the finger Operation on the finger was performed in Pittsburgh a month ago On examination there is present a linear scar on the palmar surface of the ring finger extending from the middle of the second phalanx to the metacarpophalangeal joint. There is complete active flexion of the metacarpophalangeal joint, but none in the interphalangeal joints. The tendons are adherent to the proximal end of the scar. Finger remains in full extension and passive flexion is normal

Operation (January 25, 1918) -Incision along the old scar The

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sublimis and the profundus tendons were found adherent to the scar in its entire extent, but not severed. A fine layer of fat was taken from the lower part of the external surface of the thigh next to the fascia lata. This fat was sutured about the tendons, and a pulley was formed at the proximal interphalangeal joint for the profundus tendon. Fine chromic gut (00) threaded on fine needles was used for this work. Wound closed. Two days after operation the patient became ill and had a high fever. Fearing that there might be a streptococcic infection of the finger I opened the wound. Only a little serum was present, but the wound was allowed to remain open. Within twelve hours the patient developed well-defined scarlet fever and was at once transferred to the Municipal Hospital. While there the fat sloughed out of the finger and the wound healed.

March 24, 1918 Wound healed No active flexion of the finger Tendons are adherent to the scar Advise second operation when the general condition of the patient is normal again

Discussion —A tedious, delicate operation was rendered useless by a slight infection which occurred either at the time of operation or when the incision was reopened. A flap incision along the side of the finger and across the crease at the distal interphalangeal joint would probably have been better than the incision along the old scar on the palmar surface of the finger. The fat which can be used in the finger must be very delicate. The coarse subcutaneous fat from the thigh, particularly in women, is not suitable. In patients who are slender, the inner portion of the fat next to the fascia lata may be employed. This fat is covered with a delicate membrane which may well make a suitable tendon sheath. The tissue about a hamstring tendon or along the tendo Achillis, as advised by Bunnell, should give a good result. A pulley should be made for the flexor tendons where they span a joint

The following two cases illustrate the suturing of tendons of the fingers under local anæsthesia

Case V—E B, a librarian, November 5, 1917 A month ago she cut her left thumb with a steel paper-knife. The incision was small and deep and it divided the tendon of the extensor longus pollicis just distally to the metacarpophalangeal joint. The second phalanx of the thumb remains in partial flexion and no active extension is possible

Operation (November 8, 1917) —Under local anæsthesia The two ends of the tendon were dissected free from scar tissue and sutured with fine chromic gut Patient could then flex and extend thumb to the normal limit Wound closed Uneventful recovery with good function except for slight adhesion of skin at site of incision

Case VI—A B, a machinist Seen at the Episcopal Hospital October 15, 1916, the middle finger of his right hand was cut transversely across the palmar surface at the distal interphalangeal joint The flevor profundus tendon was severed. The wound healed but the distal phalanx of the finger could no longer be actively flexed.

#### PLASTIC (RECONSTRUCTIVE) SURGERY

Operation (February 27, 1918) —Under local anæsthesia A transverse incision across the distal crease of the finger with a connecting lateral longitudinal incision made a skin flap which was turned to one side to expose the entire palmar surface of the finger The flexor profundus tendon could not be found. Its proximal end had probably retracted into the palm of the hand, where the patient says he has a point of tenderness on pressure. A strip of fibrous tissue which was adherent to the distal end of the profundus tendon was sutured to the sublimis tendon at the distal end of the proximal phalanx. Wound closed

Discussion —This operation may prove insufficient to secure active motion of the distal phalanx. If necessary, a second operation can be done to expose both ends of the profundus tendon and to unite them by splicing or by using a portion of a tendon of the foot as a graft

Case VII (Reported in Transactions of the Philadelphia Academy of Surgery, October 1, 1917, Annals of Surgery, January, 1918) — J D Episcopal Hospital, June 18, 1917 The ring finger of his left hand is contractured at the metacarpophalangeal and the proximal interphalangeal joints and is flexed completely into the palm Extensive dense scar tissue is present in the flexure of the joints. The deformity is the result of an injury sustained twelve years ago. He is a leather-worker

Operation (June 27, 1917) —The scar tissue was excised from the finger, leaving a raw surface extending from beyond the proximal interphalangeal joint to the distal palmar transverse crease. The flexor sublimis and profundus tendons were then lengthened to allow the finger to be extended. It was then found necessary to excise a portion of the distal extremity of the proximal phalanx in order to permit of free motion in the proximal interphalangeal joint. The pouch of skin on the dorsum of this joint was used in part as a flap to cover the flexor surface of the joint. The remaining raw surface was covered by a pedicled skin graft from the left thigh

Operation (July 11, 1917) —The pedicled graft was cut free from the thigh The graft was firmly united to the hand

September 17, 1917 The wound of the hand gradually healed after a little sloughing of the graft along one margin. The tendons were exposed for a time but did not slough

The finger is straight. The skin graft has made a thick pad of tissue at the base of the finger. No active flexion of the finger is present and but slight passive motion. The patient has returned to work

February 11, 1918 The finger is straight. There is active flexion of the metacarpophalangeal joint to a right angle. No active motion in the interphalangeal joints. Slight passive motion in the distal joint but none in the proximal. The skin graft is thick and prominent Sensation is present in the graft except along its ulnar margin. This patient can probably be further improved by another operation which will free the tendons from scal tissue, secure better motion in the

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proximal interphalangeal joint by excision of another portion of the proximal phalanx if it is found necessary during the operation, and

which will reduce the thickness of the skin graft

CASE VIII - G W Episcopal Hospital In August, 1917, the patient was struck in the forearm by a piece of steel which buried itself in the muscles At operation the surgeon had difficulty in finding the steel and made a fairly extensive dissection in his search Finally the steel was withdrawn by the application of a strong magnet The wound healed promptly without complication

October 1, 1917 Referred to my service Examination shows the flexor tendons of the fingers to be adherent to the scar of the incision The fingers are held in partial flexion and cannot be fully extended either actively or passively Active flexion is incomplete There

is hyperæsthesia and numbness of the middle finger

Operation (October 17, 1917) —Longitudinal incision to one side of the scar Flexor tendons were dissected free of all scar tissue and were surrounded by a free fat transplant from the thigh Wound

November 5, 1917 Wound healed, light massage ordered Good use of hand

November 19, 1917 Able to make good fist The fat transplant moves up and down with the tendons No pain at any time in arm Normal function of the hand There is complete active extension of wrist and fingers and almost complete hyperextension of the wrist when the fingers are kept extended Normal sensation in the middle finger

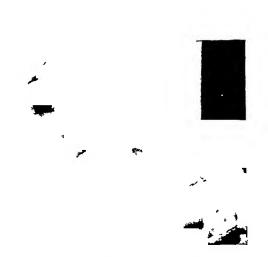
Discussion — This case illustrates the fact that a clean operative dissection of the forearm may be followed by adhesions which greatly interfere with normal use of the hand It is the author's opinion that in any operation, primary or secondary, which requires a dissection of the structures of the forearm, measures should be employed to prevent adhesions of these structures to one another and to the skin The simplest and probably the best means of prevention is the free fat transplant Cases nine and ten, in which clean operations were also productive of dense scar tissue, confirm this opinion

CASE IX —G F Episcopal Hospital In July of 1917 the patient fell from a stack and cut his left forearm transversely to the bones on the palmar side about the junction of the middle and lower thirds He was treated in a hospital for three weeks, within which time he was operated on

October 5, 1917 Examination reveals a deep transverse scar on the palmar surface of the left forearm The arm and hand below the scar are slightly bluish in color and cool, and are without sensation The patient says the hand "feels dead" There is complete ulnar and median paralysis below the scar, accompanied by wasting of the muscles of the hand The fingers and wrist are in a position of extension, and there is complete absence of active flexion of the wrist and fingers and thumb except for slight power in the radial flexor of the wrist



Fig i —Case IX April 9 1918



F1G 2—Case IX May 1918



Fig 3 —Case X May 1918



Fig -Case XI April 1918



FIG 5 — Case XI April 1918

#### PLASTIC (RECONSTRUCTIVE) SURGERY

November 19, 1917 The patient has had treatment by massage and has developed very slight active flexion of the metacarpophalangeal and the proximal interphalangeal joints

Operation (November 21, 1917) — Through a longitudinal incision all the structures in the lower half of the forearm were dissected free from dense scar tissue The dissection had to be carried down to the bones and the interosseous ligament. The ulnar nerve was found fastened to a tendon, the ends of the median nerve were buried in scar tissue, and but one or two tendons were found united The ulnar artery had evidently been ligated at an earlier operation, as it was not patulous The dissection of the nerves and tendons was carried down beneath the annular ligament until they were completely free of adhesions All the tendons were lengthened to permit of their proper suturing The two nerves also were lengthened and sutured Fat was then taken from the thigh and placed between the deep tendons and the bones, another layer between the deep tendons and the superficial ones, and a third layer between the superficial tendons and the skin Tubes of fat were sutured about the two nerves The skin incision was closed, and the hand and arm were placed on a dorsal splint

December 24, 1917 Along the line of the old transverse scar the skin sloughed a little, and the underlying fat became infected. The patient has slight active flexion of the wrist and metacarpophalangeal joints, but none in the interphalangeal joints

January 7, 1918 Some of the superficial tendons of the arm have sloughed out. The wound has been treated from the beginning with dichloramine-T, and it is now healed. There is active motion of the radial and ulnar flexors, slight motion in the metacarpophalangeal joints and some motion in all the joints of the fingers and thumb. Sensation has returned on the dorsum of the hand.

March 4, 1918 There has been steady improvement in all active motions and in sensation

April 4, 1918 Almost normal active motion of the wrist and about one-half normal active flexion of the fingers and thumb Sensation has returned to the hand and fingers except in the median and the ulnar distribution. The superficial tendons are adherent to the scar

Operation (April 17, 1918) —An incision was made at the side of the former one. The superficial tendons were found to be ununited, with their ends separated about two inches, while the deep tendons were all united but were partially adherent to scar tissue. The two nerves were also ununited, and the proximal end of the ulnar nerve could not be found. Again the superficial flexors were sutured after being lengthened. The tendons of the little and ring fingers were sewed together above and below the gap and a part of one tendon was used to bridge the gap. The same procedure was employed with the superficial flexor tendons of the index and middle fingers. The median nerve was spliced and sutured. Fat from the other thigh than the one used at the first operation was placed between the deep and the superficial tendons, and between the superficial tendons and the skin. The hand and arm were dressed on a dorsal splint.

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Discussion—A free fat transplant must of necessity secure nourishment and a new blood supply from the surrounding tissues, if it is to live. It may do this with difficulty when the tissues with which it is in contact are scar tissue with but scanty blood supply

In this case three layers of fat were introduced within the arm, and it is not to be wondered at that the scar tissue in the skin, together with the superficial layer of fat, failed to secure proper nourishment and sloughed But the surgeon should not be discouraged if in an extensive plastic operation he does not secure an ideal result at the first attempt. If he be able to improve the condition in part by successive operations, a good result will be obtained in the end

In this case a result from the suturing of the nerves is scarcely hoped for In fact at the second operation the proximal end of the ulnar nerve was not found. If the tenoplastic work has now been accomplished, the proper nerve-suturing must be attempted at a later operation, when the ulnar nerve may be exposed above the present wound and followed downward.

Case X—M McD Episcopal Hospital On August 27, 1913, this patient, a girl of six years of age at the time, fell from an express wagon and suffered a fracture of the right humerus at the elbow. She was taken at once to the receiving ward of the Episcopal Hospital and the arm was dressed in a position of hyperflexion of the elbow. An X-ray picture taken the same day showed that the fracture had been reduced. She was dressed again two days later, August 29th, in the surgical dispensary. Blood blisters were present on the forearm. There appeared to be no feeling in the hand and fingers. No pain. On October 7, 1913, she was seen by Doctor Ashhurst who found the following conditions elbow motion, 75 to 135 degrees. Slough on ulnar surface of forearm two and one-half inches long and one inch wide, which seemed to involve only the skin and subcutaneous tissues. No sensation below the wrist. Beginning Volkmann's contracture. Hand in mid-pronation with scarcely any rotation possible.

November 3, 1913 Motion of elbow 50 to 130 degrees Granulating wound on ulnar surface 10 cm above the ulnar styloid, 30x20 cm Wrist extends 20 degrees, flexes 45 degrees Claw hand When wrist is flexed to the limit, the fingers can be fully extended Sensation present in radial nerve distribution on the outer side of the web between the thumb and index finger, and nowhere else No sensation in median nerve distribution. The only sensation in the ulnar distribution is on the ulnar surface of the fifth metacarpal

November 24, 1913 Wound healed Massage and active and passive motion ordered

December 8, 1913 Sensation has returned in the distribution of the radial nerve Rotation of the forearm has slightly improved

December 22, 1913 Slight power in the lumbrical muscles

January 5, 1914 Fingers can be straightened when wrist is extended Improving

#### PLASTIC (RECONSTRUCTIVE) SURGERY

February 16, 1914 Anæsthesia present chiefly in the ulnar distribution

March 9, 1914 Wrist can be slightly hyperextended Dorsal ulnar and median anæsthesia, palmar anæsthesia distally from web of fingers except the thumb

Operation (March 25, 1914) —By Doctor Ashhurst Dissection of the structures of the forearm The incision was closed without placing any fat about the structures beneath

April 20, 1914 Active movement of the flexor profundus digitorum in the middle and ring fingers, doubtful in index and little fingers Sublimis active in all Extensors of fingers slightly active Thumb flexors and adductors mactive Massage and passive motion ordered

October 12, 1914 Elbow motion 30 to 155 degrees Anæsthesia on extensor surface of two terminal phalanges of middle finger and on flexor surface of tips of index and middle fingers. Some power in deep and superficial flexors of the fingers

August 20, 1915 Thumb much improved Elbow motion and areas of anæsthesia unaltered

October 1, 1917 The patient disappeared and has had no treatment during the past year Elbow motion 45 to 155 degrees. The right forearm is much smaller than the left and is one inch shorter. Absence of rotation, forearm in mid-position. The hand is in extreme flexion and cannot be extended to the straight line, and it is deviated to the ulnar side. There is slight active flexion of the fingers, but none of the thumb. The patient does not use the right hand. The forearm is very small and the structures are apparently imbedded in dense scar tissue. There is very little muscle tissue remaining. Operation advised for cosmetic purposes.

Operation (October 7, 1917) —By the author The structures of the forearm were dissected free from dense scar tissue. All the tendons were lengthened to permit full extension of the wrist and fingers. Fat from the thigh was placed between the tendons and beneath the skin. The muscles of the forearm were found to be almost altogether replaced by fibrous tissue.

May 6, 1918 Normal sensation in hand and fingers. Wrist and fingers are in a position of extension to almost a straight line. Normal active flexion of the wrist. Active and passive extension of the wrist to 180 degrees. Slight active flexion of the metacarpophalangeal joint of the index finger, none of the middle finger, and good of the fourth and fifth fingers. Very slight active flexion of the interphalangeal joints of all fingers but the middle one. Complete active and passive extension of the fingers. Abduction, adduction and opposition of the thumb are good, but there is no active flexion. The patient uses her hand for many purposes, and is able to pick up objects between the thumb and index finger.

Discussion —This case indicates that operation for Volkmann's contracture may be useless and even harmful unless layers of fat are placed about the dissected structures to prevent re-adhesion

#### A BRUCE GILL

This child was operated on to remove the unsightly contracture of the hand. This has been accomplished. But she is developing an unhoped-for function of the hand, and the small wasted bellies of the muscles of the forearm below the elbow seem to be growing larger. There is good power in the extensor group of muscles and good power in the flexors of the wrist. The surgeon should never consider a case hopeless, as some improvement can almost always be secured. Possibly a later operation in this case to free further the flexors of the fingers and the thumb may lead to a development of these muscles which now appear to be wasted away. Tendon transplantation may also improve the function of the fingers and the thumb

Case XI—K B Orthopædic Hospital This patient lives in Youngstown, Ohio In February of 1917 her right arm was injured in a machine The elbow was broken and the back of the hand was badly lacerated. She was treated in a hospital for a month

December 22, 1917 An irregular cicatrix is present on the outer aspect of the arm and elbow. The external condyle of the humerus is sharp and prominent. The elbow is fixed in absolute ankylosis at 130 degrees, and the forearm is fixed in almost full pronation. There is but 15 degrees of rotation possible. On the dorsum of the hand is a broad scar which is adherent to the extensor tendons of the fingers. The hand is in a position of slight palmar flexion and ulnar deviation and cannot be extended beyond 180 degrees. Active extension of the fingers is complete. Active and passive flexion of the metacarpophalangeal joints are almost completely absent, and there is but very slight active flexion of the interphalangeal joints.

Operation (January 18, 1918) —(1) Excision of the elbow through an external lateral incision (2) Through a longitudinal incision on the dorsum of the hand the extensor tendons were dissected free from the skin and from the bones of the hand. A free fat transplant from the thigh was placed underneath and over the tendons, and the wound was closed. But very slight passive motion of the metacarpophalangeal joints was possible under ether

February 7, 1918 Elbow wound healed Incision on hand has opened slightly at one end Patient has almost normal motion in interphalangeal joints. She wrote a letter to-day, the first one for a year

February 22, 1918 Passive motion of elbow 60 to 160 degrees without pain Very slight active motion

March 16, 1918 Normal flexion and extension of interphalangeal joints. Very slight motion in metacarpophalangeal joints. Active motion of elbow 90 to 180 degrees, passive motion 60 to 180 degrees. Lateral stability good. Rotation of forearm is one-half of the normal.

April 4, 1918 Active motion of elbow 60 to 180 degrees, passive motion 35 to 180 degrees without pain. Active rotation of forearm one-half of the normal, passive two-thirds of the normal. Normal motion in fingers except in the metacarpophalangeal joints. A small superficial piece of fat sloughed from the wound in the hand. Wound now almost healed. Use of hand and arm has been showing improvement week by week.

#### PLASTIC (RECONSTRUCTIVE) SURGERY

Discussion —In this case also there was slight sloughing of part of the fat transplant, due, probably to the poor vascularization of the skin in the region of the scar Here no damage was done, however, as the tendons did not become exposed in the wound

Aside from the subject of this paper there may be noted in this case the good result which follows excision of the elbow for old fractures or fracture-dislocations. This patient now uses her hand and arm for dressing her hair, for feeding herself, for writing and for many other important functions, all of which were lacking before her operation.

These cases illustrate the variety of operative procedures that must be employed plastic work on tendons, nerves, and skin, skin, fascia, tendon, and fat grafting, excisions and arthroplasties of joints

Conclusions—Many of the numerous cases of partial or complete loss of function of the fingers, the hand, and the forearm due to infections or to injuries may be greatly improved or entirely cured by proper surgical procedures. It may be necessary to perform a number of operations in the severe cases to obtain a good result. Operative measures should not be postponed too long, particularly in those cases which begin to show trophic changes in the joints. Patient and prolonged after-treatment is frequently required, but in this the patient is usually a willing helper because he notes the continued improvement in his condition. Finally, it may be said that one seldom finds a more grateful man than he who has had restored to him the function of a hand which he had despaired of ever using well again.

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# FIBRIN PAPER AS AN HÆMOSTATIC AGENT By Samuel Clark Harvey, M D

CAPTAIN, MORC, U B A

(From The Laboratory of Surgical Research, Harvard Medical School)

THE control of hemorrhage from vessels of sufficient size and so situated that they can be readily clasped and tied has been for many years a simple matter. Quite otherwise is the hæmostasis of multiple small vessels in the cut surface of an organ, such as the liver or kidneys, or of thinly-walled vessels surrounded by delicate tissue, as in the brain. The application of clamps leads only to further bleeding, and the use of mass sutures to the extensive destruction of tissues which may be of vital importance.

Many measures have been suggested for the control of such bleeding. The use of styptics, such as ferric chloride, or the actual cautery aims at the production of an artificial coagulum and is unsatisfactory because of its inefficiency and the large amount of tissue damage.

In more recent years, since the intensive study of the factors involved in the coagulation of the blood, many workers have attempted to hasten the normal coagulation by the use of various physiological and chemical methods <sup>1</sup> Naturally these were first tried and most successfully applied in circumstances where the coagulation of the blood was lowered. An instance of this is the use of horse serum in hæmophilia

The majority of cases in which this type of bleeding is embarrassing is in individuals with a normal coagulation time, and the use of such agents is merely an endeavor to hasten the normal process. Several reagents have been described with this in view, among which the most notable are the "Coagulen" of Fonio,<sup>2</sup> the kephalin of Hirschfelder and the tissue juice of Fischl. All these aim at the introduction of a strongly thromboplastic substance. That these are effectual within certain limits, especially when used in combination with pressure, may be true, but one can hardly say whether the effect is due to the hastening of a normal coagulation or to the mechanical control while the normal coagulation is taking place.

It is usually found that a piece of cotton wet in salt solution pressed firmly on the bleeding area will control the hemorrhage 4 until such time as it is necessary to remove the cotton, when it brings the coagulum away with it, thus starting the flow anew. It is obvious at once that the use of an absorbable tissue would enable one to close the wound without any disturbance of the coagulum. With this in view it has been customary to bring the omentum over the bleeding surface of the liver or to introduce fascia for the same purpose \* For troublesome bleeding in brain surgery Cushing 4 described the use of bits of muscle. Horsley 5 investigated its value experi-

<sup>\*</sup>For the literature concerning the use of these tissues as hæmostatic agents see Grey \*

# FIBRIN PAPER AS AN HÆMOSTATIC AGENT

mentally and stated that it possessed the following requisites, "asepticity, adhesiveness, and thrombokenosis" Risley, in this laboratory, compared fat, fascia and muscle used in this manner and found the last most effective. All these tissues, he concluded, could be safely used, they underwent fibrous changes and ultimately formed a firm union with the parenchymatous tissues.

The obtaining of sufficient amounts of such tissue often involves the making of separate incisions or the sacrifice of considerable tissue in the wall of the original wound. To avoid this Grey titudied the use of fibrin obtained from sheep's blood. This was washed and sterilized in salt solution and used as one does cotton, it being closed within the wound. It was found to be more effective than the cotton, inasmuch as it adhered more readily to the bleeding surface. In comparison with muscle embedded in the cerebral hemispheres of cats, the absorption of the fibrin was found to be more rapid and attended by less reaction. Either tissue was resolved in about six weeks. For blocks of fibrin measuring  $25 \times 35$  cm, the tolerance of the tissues was good, the resolution being necessarily much slower.

This substance, although ideal from the standpoint of hæmostasis and absorption, was found to be somewhat cumbersome in its adaptation to the routine of the operating room. Consequently, a method has been evolved for converting the fibrin into a paper-like substance, with a considerable gain in ease of preservation and handling

The method found most suitable for the preparation of this fibrin paper is as follows. The fibrin of beef blood is obtained from a slaughter house This is passed through a fine meat-chopper and then washed in running water for twenty-four hours in order to free it of the other constituents of It is then shredded by prolonged trituration in a mortar and shaken up with about twice its volume of water. This is thrown, while in suspension, into a tray with a screen bottom, over which is laid a single layer of ordinary surgical gauze With a slight oscillatory movement of the tray, the water runs through, leaving an even layer of fibrin deposited on the gauze This is covered with another layer of gauze and turned out on a towel, being handled gently so as not to tear the fibrin film whole is placed between two towels of double thickness and introduced between two pressure plates, as shown in Fig I These plates are approximated with as great pressure as possible by the tightening of the bolts inserted at their edges The apparatus is placed in an autoclave and treated with steam pressure of 15 to 20 pounds for thirty minutes On removing the film it is found to be "welded" into a sheet of paper-like material from which the gauze can be readily stripped off, leaving a rough surface thickness of this sheet depends of course upon the amount of fibrin thrown on the screen

This fibrin paper is of a greyish brown color and on section shows a smooth, brown, homogeneous surface like that of gutta-percha. It is quite elastic and possesses a surprising amount of tensile strength. When damp

# SAMUEL CLARK HARVEY

it can be handled like any fabric, but on exposure to the air it dries, becoming hard and somewhat brittle. When placed in water it rapidly softens and resumes the appearance shown on its first removal from the autoclave. On heating, water is first driven off and then the material burns much as does horn and with the peculiar odor of burning horn or hair. Boiling or further sterilizing with steam has no effect upon it, thus enabling one to sterilize it repeatedly. It is not soluble in alcohol, ether, chloroform or acetone, these substances drying it and rendering it brittle. Strong acids and alkalies cause it to swell and they slowly digest it, while the action of these substances in dilution is scarcely perceptible.

It is possible by using a pressure cylinder to turn out blocks of the

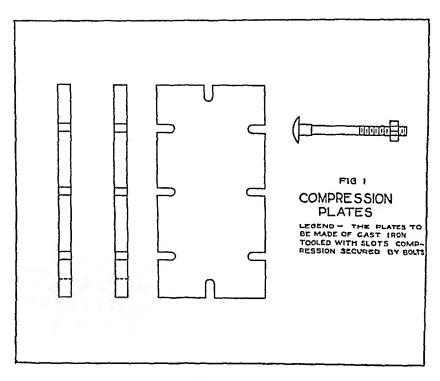


FIG I

material which can be cut directly with the microtome so as to form stamps some 15 to  $18\mu$  in thickness. When dried these blocks can be drilled or turned on a lathe in much the same manner as can be done with hard rubber

For the purpose of hæmostasis this substance was tried as cut by the microtome in quite thin sheets, and in the paper form as removed from the press with the thickness of about 0 5 mm

The thinner form seemed preferable because of the small amount of material introduced into the wound, but on trial the smooth surface did not stick so well as the paper with the roughened surface as left by the removal of the gauze Consequently the former was discarded for hæmostatic work

The thicker paper proved admirable as a hæmostatic agent Small pieces

#### FIBRIN PAPER AS AN HÆMOSTATIC AGENT

the size of a stamp placed over arteries as large as the secondary mesenterics of a dog were found to control the bleeding after 1 to 2 minutes of pressure. The liver and kidneys of dogs were transected with a knife, a piece of the fibrin paper inserted and the split halves brought together with sutures, with control of the bleeding. Many times in the course of another series of experiments the gall-bladder was stripped from the surface of the liver in the dog, leaving a smartly bleeding surface. This was covered by a layer of the fibrin paper held in place by a pack of gauze. On removal of the gauze at the end of the operation, in each instance the bleeding was found to be perfectly controlled and the wound was closed with the fibrin in place. No further bleeding took place and the film was ultimately organized, as was shown by section of the animals from a few weeks to many months later.

Its use was also tried in the clinic, where bleeding vessels in the cortex of the brain and in the dura, as well as bleeding from sinuses, was readily controlled. In these instances it acted certainly as effectively as fascia and almost, if not quite, so well as muscle. In a rupture of the liver in which it was possible to suture only the lower end of the tear, the upper end was packed with this fibrin and the wound closed. There was no further bleeding and the recovery was uneventful. In none of these cases were any bad effects observed from its use

The absorption and resolution of the fibrin was studied in rabbits, cats and dogs. All the experiments were carried out under anæsthesia and with the strictest surgical technic. Pieces of the fibrin were inserted in the liver, kidneys and brain and these organs sectioned at varying intervals from a few days up to many weeks. The microtome stamps, some 15 to  $18\mu$  in thickness, were found to have disappeared in from six to ten days. The cellular reaction was the same as that noted by Grey  $^{\tau}$ . With the fibrin paper which was about 05 mm in thickness the process was prolonged, it taking from 6 to 8 weeks to effect a final resolution. The microscopic picture is practically the same as that seen in the absorption of a catgut stitch. Healing is ultimately accomplished with the formation of only a slight scar at the site of the implantation

For use in the operating room the paper is made as thin as possible, is sterilized in the autoclave for one hour and then allowed to dry, in which condition it can be stored for months. When desired a piece is dropped in the instrument sterilizer and boiled for ten minutes, after which it is kept in sterile salt solution until used. In this way one has always at hand an absorbable, sterile material, easily handled, with which this type of bleeding can be controlled and which can be safely closed within the wound

#### SUMMARY

Bleeding from multiple small vessels, from vessels in delicate tissue and from sinuses can be controlled by the application of fascia, muscle or fibrin. The peculiar advantage of the use of these tissues is that they can be

The peculiar advantage of the use of these tissues is that they can be left within the wound, thus avoiding the danger of stripping off the coagulum

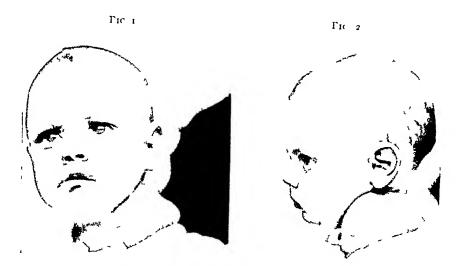
#### SAMUEL CLARK HARVEY

A method is described for converting fibrin into a fabric easily kept, sterilized and applied. This material is found to correspond in effectiveness and amenability to absorption with the untreated fibrin, while being far more adaptable to the operating-room technic

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FIGS 1 and 2 -Cwernous angioma of the neck

# TRANSACTIONS

OF THE

# PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, held February 7, 1918

The President, DR EDWARD MARTIN, in the Chair

EXTENSIVE CAVERNOUS ANGIOMA OF THE NECK TREATED BY RADIUM

DR D L DESPARD and DR C B LONGENECKER (by invitation) presented a child, observed by them in the Surgical Department of the Jefferson Medical College Hospital

The mother stated that the growth had become noticeable a few months after birth, and while at first small had rapidly increased in size until the present time. When presented there was a large cavernous angioma occupying practically the entire left posterior triangle of the neck (see Figs 1 and 2).

The growth seemed to take its origin not only from the floor of this triangle, but also from beneath the clavicle and from behind the lower half of the sternocleidomastoid muscle. It was entirely subcutaneous, without skin involvement, beyond a slight dusky discoloration, where the veins or the dilated endothelial spaces approached the skin surface and could be seen through it. These could be felt upon palpation, were easily compressible, only to recur upon the withdrawal of the pressure. In view of the hazards attending operation for its removal, he consulted Doctor Newcomet in regard to radium, who was of opinion that it might be materially shrunken by its application. So the child was placed under his care and later when Doctor Newcomet entered the Military Service, Doctor Longenecker continued the treatment, with a brilliant result

# PLASTIC RECONSTRUCTIVE SURGERY OF THE HAND AND FOREARM

DR A BRUCE GILL read a paper with the above title, for which see page 55 He also presented for examination the patients who had been under his care, demonstrating the results secured

DR PENN G SKILLERN, JR, said that the point which Doctor Gill brought out in regard to making incisions in the normal horizontal flexion creases in preference to vertical incisions is worthy of emphasis. The difference between these two incisions is just this the vertical incision across a flex on crease is followed by keloid overgrowth and deforming contracture, the horizontal incision through or in a flexion crease is followed by an invisible scar. He recently removed a luxated semilunar by cutting through the proximal

#### PHILADELPHIA ACADEMY OF SURGERY

flexion crease of the wrist at the end of two weeks no scar could be found In transplanting the palmaris longus in its sheath to the little finger by the method which he recently described (*Medicine and Surgery*, December, 1917, 1108) he exposed the empty flexor tendon sheath of the little finger by raising an anterior flap from the flexion surface in the following manner Two horizontal incisions were made—one through the distal flexion crease of the little finger and the other through the flexion crease of the palm—and these two incisions were connected by a longitudinal incision along the ulnar border of the little finger, by raising this quadrilateral flap and reflecting it to the radial side excellent exposure of the desired field was obtained

Doctor Gill stated that in the case of tenolysis in which he transplanted fat-fascia lata to the wrist and arranged it in three tiers to enwrap the flexor tendons he had difficulty from necrosis of the overlying skin, due to the excessive tension to which it was subjected from bulging of the large amount of fat and fascia stuffed into the forearm. In these cases of tenolysis of many closely-related tendons it is Doctor Skillern's practice to take the flat piece of fat-fascia transplant and, with the fat side toward the tendons, arrange it in and out among the tendons until it resembles a corrugated board, the summits of every two adjacent corrugations are then stitched together, thus forming a series of tendon sheaths, the free lateral borders of the transplant are sutured to the cut lateral margins of the deep fascia so as to anchor the corrugated tendon sheath. This method, originally devised for a case of old Volkmann's contracture, has been uniformly successful

DR GWILYM G DAVIS called attention to the service of a fat flap The cargyle membrane had been used, especially in treating contracture of the forearm and hand, but the serous discharge which occurred in these cases was apt to expel the membrane Doctor Gill has demonstrated that in these operations, as in bone surgery, the autogenous graft has been the most desirable

Since the discussion has included the question of finger tendons he would mention a method which he had found of service in one patient was injured by a cut across the palm dividing the flexor tendons of the little and ring fingers When the man was seen some considerable time after the injury he found on cutting down upon the hand that the proximal ends of the tendons had contracted to such a degree that he did not feel justified in splitting the hand as far as would be necessary in order to reach them He, therefore, made an incision and divided the superficial flexor of the good finger in two parts—one part was attached to the deep flevor of the little finger and one part to that of the ring finger The wound healed up well and the result was very satisfactory He mentioned this case simply to show one of the many combinations of operation possible to do in these tendon cases Of course, one must not be satisfied with simply doing the There must be a long series of after-treatments In speaking in this connection at the meeting of the College, Dr R Tait McKenzie said that in the after-treatment of such cases if the cicatricial scar is not pro-

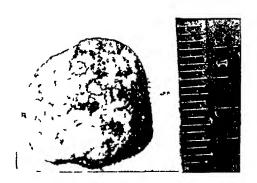


Fig. 3 —Gall stone producing obstruction of bowel

#### INTESTINAL OBSTRUCTION DUE TO GALL-STONE

nounced, hot water baths, etc, may be used A marked scar, however, is apt to be softened by the hot water bath, resulting in a raw surface and interference with healing. The selection of the postoperative treatment must be made with much care

#### INTESTINAL OBSTRUCTION DUE TO GALL-STONE

DR W E LEE and DR HELEN J LEMAISTRE (by invitation) presented a woman, aged fifty years, who had been in good health up to April, 1917, when she began to suffer from constipation and mental depression. In July she was seen by Dr. F. T. Stewart who made a diagnosis of cholecystitis In January, 1918, she complained of nausea and vomited bile Examination elicited great tenderness over gall-bladder and right iliac region, no rigidity Temperature was only about 100°, pulse 100 and weak Food was withheld and flaxseed poultice applied Next day pain was localized over stomach, and fractional doses of calomel administered The following day (third), after a good loose bowel movement, the patient again vomited greenish bile and in a few hours her abdomen was found to be distended and there was rigidity over gall-bladder area with marked sensitiveness in Enema was followed with good result and distention disappeared The fourth day (January 24th) there was distention over lower abdomen with diminished peristalsis There was frequent vomiting of bile which was induced by any movement on part of patient. Stomach lavage resulted in the withdrawal of unmixed bile. Flaxseed poultices applied over distended area with moderate effect and enema result was found negative for distended area with moderate effect and enema result was found negative for blood and bile. Seen by Doctor Lee the evening of the fifth day (January 25th), at which time there was rigidity over gall-bladder area with continuing tenderness in epigastrium, distention of the transverse colon, absence of peristalsis and partial obstruction of bowels. Exploratory operation advised Early the next morning the patient vomited a large amount of very dark fluid with decided fecal odor and she complained of intense pain in gall-bladder region. Distention unrelieved, though bowels moved voluntarily with large amount of partly formed stool, containing fresh blood and clots of a clear mucoid material with shreds of tissue. Laboratory examination showed this tissue to be fragments of involuntary muscle and fibrous tissue. showed this tissue to be fragments of involuntary muscle and fibrous tissue heavily infiltrated with red blood-cells and polymorphonuclear leucocytes, denoting acute inflammation Patient removed immediately to General Hospital and shortly after arrival had several more bowel movements, mixed with fresh blood Operation delayed, as it appeared that the obstruction was relieving itself. A few hours later (sixth day after onset of symptoms) she passed a large biliary calculus per rectum and distention gradually subsided. From this time (two weeks ago) patient has made a surprisingly rapid recovery. There is still sensitiveness on palpation over gall-bladder area but bowels are moving normally and patient is able to digest semi-solid food comfortably. The fæces are now of a light brown color and partly formed consistency, with no evidence of bile or blood

#### PHILADELPHIA ACADEMY OF SURGERY

# THE SWIFT-ELLIS METHOD OF TREATMENT IN CEREBROSPINAL SYPHILIS

DR B A Thomas presented his experiences with the intraspinal method of treatment of cerebrospinal syphilis. He mentioned the anatomical considerations which prompted Swift and Ellis to suggest and utilize the intraspinal injection of autosalvarsanized serum in the treatment of this disease. Attention was directed to the fact that in his experience with twenty-five cases, deductions were necessarily inconclusive, because the cases on the one hand had been treated intensively intravenously so long as improvement was manifested clinically and serologically (including examination of the spinal fluid), and on the other hand, to the fact that many cases had been referred primarily for the Swift-Ellis treatment, receiving an insufficient number of injections, and as shown by the analysis in the table of cases presented, an absolutely inadequate amount of treatment for permanent results. The technic in general was outlined, and precautions stipulated as to dangerous procedures.

Attention was directed to the fact that in a few cases of tabes treated by intravenous injections only of salvarsan, the results thus far have been apparently just about as good as in other cases, in which the intravenous injections were supplemented by intraspinal injections of autosalvarsanized serum

In the treatment of paresis, Doctor Thomas believed that salvarsan, either intravenously or intraspinally, possessed no advantages over mercury and the iodides, and in fact was likely to be harmful

From his experience, Doctor Thomas believes that the question of the value of intraspinal medication in the treatment of cerebrospinal syphilis is still an open one, and does not believe that it should be resorted to so long as improvement can be obtained from intravenous injections alone of salvarsan. He strongly believes that mercury and the iodides still continue to be indispensable remedies for the best treatment of cerebrospinal syphilis, although their administration in certain types of this form of the disease may and should be preceded by intravenous injections of salvarsan, and possibly by intraspinal medication if further improvement is no longer manifested following the intravenous injection. Certainly patients with marked cordical degeneration offer little if any hope of improvement by this or any other known method of treatment.

#### CARCINOMA OF THE PENIS

DR B A THOMAS presented a negro, aged thirty-seven, who came to the Genito-urinary Department of the Polyclinic Hospital in the latter part of December, 1916, with a history of life-long phimosis. A year prior to admission he noticed a subpreputial discharge, and a few months later the glans penis began to enlarge, and a bloody discharge appeared from the preputial orifice. Examination revealed an indurated irregular ulcerating mass

#### EPITHELIOMA OF THE FACE

four to six centimetres in dimensions, involving the entire glans. The inguinal lymph-nodes were palpable, the Wassermann reaction was negative

On January 5, 1917, a bilateral inguinal lymphadenectomy, followed by total extirpation of the penis, was performed under ether anæsthesia. The laboratory report rendered by Doctor Kolmer showed a squamous-celled carcinoma, with very early involvement of the lymph-nodes. During his stay in the hospital, the patient was given intensive X-ray treatment, in the hope of preventing recurrence. The patient was discharged from the hospital exactly four weeks after the operation

The patient was exhibited to show the satisfactory results, masmuch as he has shown no signs of recurrence to date, over two years. He has complete control of urination, obviously assuming the sitting posture, and is actively engaged in laboring work.

# Stated Meeting, held March 7, 1918

The President, DR EDWARD MARTIN, in the Chair

# EPITHELIOMA OF THE FACE FOLLOWING X-RAY TREATMENT OF A KELOID

MR J S RAVDIN presented a woman, aged forty-one years, who was admitted to Dr Chas H Frazier's service at the University Hospital, November 20, 1917, with a "running sore" on the right side of the face and the neck

At fifteen she had typhoid fever, during which time she developed an abscess in the right mastoid region. This was lanced and pus was evacuated. A few years later a keloid appeared in the scar and this was followed by another keloid below the scar. These enlarged until when she presented herself for treatment at the Howard Hospital in 1902, the original keloid covered the entire mastoid process, while the lower one extended from the tragus of the ear above to below the angle of the jaw below, and from the anterior border of the sternocleidomastoid to the anterior border of the masseter.

Doctor Frazier removed the upper keloid, but it was followed by a recurrence. The patient was then referred to Doctor Pancoast for X-ray treatment. This was in the latter part of June, 1903. X-ray treatment was continued over a period of about four years. The doses were not measured. At the time of her discharge in 1908 the keloids had practically disappeared, there remaining only a scar. She was told to return occasionally for observation, but this she failed to do

In 1915, after a latent period of eight years, she returned The skin at the site of the keloids had broken down X-ray treatment at this time was futile On November 20, 1917, she was admitted to Doctor Frazier's service Examination at this time showed at the angle of the right jaw and extending on to the cheek anteriorly and the mastoid process pos-

#### PHILADELPHIA ACADEMY OF SURGERY

teriorly a sluggish ulcer Its edges were indurated and everted It was not very movable on the underlying tissues. A serum exuded from it, which was odorless. It was painful. There was no glandular involvement.

The patient was operated on November 26th, and the area was excised by a wide circular incision. The growth did not seem to infiltrate the underlying tissues. The edges were seared with the actual cautery, bleeding points controlled, but no attempt was made at closure of the wound

C A Porter and S B Wolbach in *The Journal of Medical Research*, of October, 1909, reported a number of X-ray carcinoma. They called attention to the latent period between the last X-ray treatment and the beginning of signs of degeneration, also to the relatively benign character of many of these epidermic carcinomas

E P Cumberbatch, in the October, 1913, number of the *Proceedings of The Royal Society of London*, reported a technic whereby he claims to get most excellent results from the X-ray treatment of keloids. He divides the area into four parts and each area is treated separately. No area receives more than one-half a pastille dose of Sabourand, tint B, and each area is given a fortnight's rest before repeating the dose

#### ADDRESS ON "SHOCK"

DR MILES T PORTER, having been introduced, said that with regard to shock one finds, especially on the part of those who have not been actually at the front in this war, a failure to recognize certain things which are obvious enough when one is actually in the work. One of these is in regard to the definition of shock When the shock case comes in, the ambulance driver or stretcher bearer used to come to report that there was a shock case There never was any question about the diagnosis The patient was the color of muddy parchment, the eyes were turned up. the whites only showing, utterly relaxed The heart is feeble, respiration in uncomplicated shock is never deep, always feeble, but more frequent than normal and the blood pressure is very much reduced. The appearance of the patient alone gives the diagnosis in these ordinary cases of shock very important to recognize the condition at the beginning, the importance lying in the fact that it is very much easier to save the patient in the early hours of shock than in the later hours If the low blood-pressure is maintained certain changes occur He knew of no other way of recognizing the very early stages than by the measurement of the diastolic blood-One need not say that every case of low diastolic blood-piessure will die of shock, but when the diastolic pressure falls to a low level, if the patient has not shock one may be certain that he will have the symptoms and difficulties of shock if the blood-pressure remains low for any length of time We have come to a point in the treatment of this condition in which the systematic taking of the blood-pressure is of as much importance as the systematic taking of temperature to judge of the continuance of fever

# ADDRESS ON "SHOCK"

systematic taking of blood-pressure he did not see practised in any of the French hospitals It would save many lives The general tendency of shock cases when once in the grip of shock is to die under the treatment, or the lack of treatment, ordinarily given to them at present, whereas, a treatment which demands no great experience, and requires only the intelligence of systematic attention to a few things, will save about four-fifths of the cases The literature of shock for the last twenty years or so contains various conclusions, various ideas, which are either entirely erroneous or which are only partially comprehended One of these ideas is that shock is due to exhaustion of the vasomotor centre. This is not the case, because it is shown that in profound shock the vasomotor centre still gives reflex change to blood-pressure on stimulation of the sciatic nerve far too great to be accounted for if the centre were exhausted Moreover, it has recently been shown that in profound shock the superficial vessels are constricted, which would not be so if the vasomotor were exhausted It is also not true that shock is due to stimulation of nerves of sensation shown that stimulation of any nerve for several hours at a time with strong currents can be made without causing shock The speaker had stimulated almost every nerve in order to find nerves the stimulation of which would In none of the cases in normal nerves was there a fall of blood-pressure, on the contrary, the general effect was to increase bloodpressure It is, however, true that patients are found in such a state that slight stimulus will produce a condition resembling shock. An example is reported in the Annals of Surgery of an interesting case cited by him twelve years ago in which a woman with cancer of the breast, with enlargement of the glands in the lower part of the neck and axilla, had suffered for many months and had had morphine and was in a highly nervous state During the operation it became necessary to put a clamp on one of the cut nerves of the brachial plexus, when the woman fell into a condition thought He did not believe that that was shock, but inhibition of the to be shock He held to that belief because previously the same clinical picture has been produced by experiments which he did and in which the animal had morphine The reason for the state was that the patient had become sensi-That conception of sensitization is new It is based upon good experimental observations The first of those observations which he had ever recorded is in the second chapter of the first volume of the Journal of Experimental Medicine, in a paper upon "Ligation of the Coronary Arteries," which was the second paper on this subject, the first having been written by Welsh and Flexner In it are reported a large number of cases, results of ligation of the coronary artery in dogs. If the artery is large there occurs sudden arrest of the heart with fibrillary contractions apt to be fatal in the dog The interesting point here is that there were several series of these experiments and in all of the series but one dose was given of morphine and cocaine, that following ligation of the left coronary artery in 50 per cent of cases there was arrest of fibrillation. A second ligation

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caused arrest in 85 per cent of the cases In other experiments made with pure ether the morphine and cocaine had so sensitized the heart that a stimulus otherwise innocent caused a fatal arrest of fibrillation Years later he found in studying the tonus of the heart muscle another state of In experiments recently published in the Journal of Experimental Medicine upon pneumonia, tracings from the heart muscle were shown from dogs that had died of pneumonia In these dogs it is found that at the end of three and one-half hours tonic contraction has taken place to an extent equal to the ordinary contraction of the heart In experiments to determine the effect on blood-pressure of stimulating the sciatic nerve a rat received morphine and cocaine When about to stimulate the sciatic nerve to obtain the vasomotor reflex we found upon lifting it that the heart "fell down", there was inhibition, frequent and feeble beat which lasted three-quarters of an hour Warm saline solution was given, and the nerve was again lifted when the heart fell into the same state, remaining so for half an hour With more warm saline solution the rat recovered and the experiment proceeded in the ordinary way

If you make a survey of the diseases in which the arteries are affected, in certain migraines in which there is prolonged restriction of the fibrillary vessels, you will see that patients subject to migraine get into a state in which a little extra fatigue or other stimuli which under ordinary circumstances will produce no such effect bring on the prolonged spasm and all indications of the disease. It is obvious that sensitization of the heart leading to prolonged inhibition is a factor in the production of shock

Then there is the hydrostatic fall, a fall which can be illustrated by an artificial scheme. The best example of a hydrostatic fall is seen in cases in which novocaine has been given carelessly. The sudden fall of blood-pressure does not last long and is rarely fatal.

The question of hemorrhage is not well understood. In the loss of blood there is a critical point below which you can take but a small quantity of blood without dangerous symptoms appearing. Just here is another point deserving of attention. The amount of blood necessary to carry on nutrition of the tissues varies with the state of nutrition in those patients. If the metabolic factor or the chemical operations of the tissues are diminished or impaired, then obviously more blood will be necessary to nourish those impaired tissues than if these elements were at their normal level. Consequently, the blood which can be lost is a variable quantity. Hemorrhage per se is not a cause of shock

These are the principal sources of confusion with regard to the cause of shock. When the speaker first went abroad in 1916 to study at the front the cause of shock, he was informed by the surgeons that shock was seen oftener in fractures of the thigh and in multiple wounds through the subcutaneous tissues. His personal experience bore this out. It has been found that the blood of such patients contains large quantities of fat. It is also known from experiments on animals and examination of tissue of human

#### ADDRESS ON "SHOCK"

beings that fat embolism takes place in this condition. Fat emboli have been found both experimentally and after shock in the human subject, after fractures they have been found especially in the lungs, brain and other organs. When he came back from France he tried to find a chemical substance which might be absorbed by bone marrow, it occurred to him that fat embolism might be the cause of shock. He demonstrated this by injecting  $3\frac{1}{2}$  c c of neutral olive oil into the jugular vein of a cat

He had taken pains since acidosis was considered in connection with shock to inquire of several persons supposed to know more about the subject than anyone else in this country. The result of that inquiry was that he should not quote them personally but that they believed that while there was no doubt that even in early stages of lowered blood-pressure the alkali reserve is diminished in the blood there is a doubt whether the amount of diminution observed in the ordinary case of complicated shock is of great clinical importance. That doubt is a very complicated matter resting upon matters which he personally is not competent to discuss. The question is whether the reduction shown by the test in the alkali reserve really does mean acidosis in the cases in which it has been said to mean acidosis.

As practical men it is necessary that we should not leave any reasonable chances untried. He, therefore, inquired what it was best to do under the circumstances. It was their opinion that where acidosis was suspected it was advisable to draw the urine from the bladder, then to administer from 3 to 5 grammes of sodium carbonate properly diluted and after an hour to test the urine reaction. If the urine were found to be alkaline no acidosis was present, if it were still acid the probability would be that acidosis was present. It is the opinion of these gentlemen that the sodium bicarbonate is not without certain potential dangers.

In the practical handling of a case of shock you should in the first place take the diastolic blood-pressure. The maximum blood-pressure is of uncertain value in shock because the arteries are well filled, the heart beat frequent and feeble, and therefore the maximum blood-pressure is impaired more than 15 mm. The diastolic pressure is a much more certain sign and it is also very easy to take. The test is of greatest importance because shock is above all a disease in which the understanding of a critical condition is vital to the saving of the patient. In shock there is a level to which the blood-pressure sinks above which level the patient is likely to recover. Below that level there is a vicious circle which results in the patient's death. That level he had called the critical level in shock. This level depends somewhat upon the instruments used. He would say that sixty was this critical level, that with a level of from 55 to 50 the tendency is to die, that with a level of 65 the tendency is to get well with almost any sort of treatment.

To summarize the patient in shock must not be washed. He must not be put into a soft bed, he must not be given normal saline solution indiscriminately without any record of the blood-pressure, the blood-pressure must not be guessed at, but must be measured every fifteen minutes. It

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takes one and three-fourths minutes to make a reading of the diastolic pressure The patient must not be warmed up in bed and then taken out of the bed without a blanket on an ordinary stretcher, carried 500 feet uncovered and given chloroform If he does not die it is because he is young and vigorous and not because he has not had ample opportunity at the hands of the surgeon All of these things he had seen done repeatedly At the head of one of the hospitals was a distinguished professor of surgery He said he was glad to see him, that all the shock cases were dying After he had been there ten days five of the cases recovered The only difference in treatment was that the things enumerated were corrected finally worked out in France has proved to be a good one When a case comes in it is taken to a little room canvased off from the part of the tent in which the operations were done. The patient is put upon a slanting table so that the feet are 30 cm higher than the head The blood-pressure is taken every fifteen minutes and if at the critical level normal saline is given with adrenalin If this does not keep the pressure up carbon dioxide is The clothes are not removed but cut away round the wound roform is never used. Whenever possible local anæsthesia is employed Operation is performed as rapidly as possible and if advisable carbon dioxide is given during the surgical procedure. The patient is wheeled back fifteen or twenty feet and the expert in charge of the case must remain with him for an hour These are the principal points in the care of the shocked case

There are a good many cases in which none of the efforts heretofore employed in shock will raise the blood-pressure. In those cases something must be done It occurred to him that it might be of value to use the respiratory pump In the use of carbon dioxide we get any type and rate of pressure we like The result of the increased action of the respiratory pump is to carry much more blood from the veins into the slightly emptied arteries and to the heart which is not properly filled. The inevitable result is that in two or three minutes from the beginning of treatment the pulse is much stronger and the blood-pressure is up 10 to 12 mm It can be raised 30 mm in animals and fifteen in man. If the blood-pressure fall to the critical level it makes a great difference in the prognosis He would suggest to utilize this extremely simple method or improve upon it maintain that fat embolism is the general cause of shock, not did he maintain that carbon dioxide respiration is a heaven-sent remedy which will remove all danger from shock 
It is of advantage in shock, but the real point in regard to treatment is to make systematic effort based upon repeated measurements instead of risking the patient's life by pure guess work

DR H A HARE said that the air hunger referred to by Doctor Porter has apparently been taken by many persons as an evidence of toxemia, meaning that the respiratory centre has been stimulated by the B oxybutyric acid or that there is an effort of Nature, by deep inspirations, to oxidize the B oxybutyric and diacetic acids into harmless acetones. He

# ADDRESS ON "SHOCK"

would not be surprised if it was found that this view is entirely erroneous. He was inclined to think that part of this deep respiratory effort which occurs under these circumstances is Nature endeavoring by the respiratory apparatus to help the heart pump, and Doctor Porter in his remarks dropped a word or two which seemed to give some emphasis to this point. He had repeatedly seen cases of pneumonia in which he had been convinced that the cough of the patient which was thought to be annoying, and which the physician tried to stop by the administration of opiates, was really an effort on the part of the respiratory mechanism to assist the heart in pumping venous blood. Deep inspirations and forcible expirations alter venous pressure, and venous pressure is one of the things which has gone wrong in this extraordinarily interesting condition.

In regard to vascular dilatation, the fundamental conception of shock held during the last thirty odd years is that taught by Horatio C Wood that shock was due to vascular palsy, is due to an accumulation of blood in the great veins. It is only within the last few years that surgeons have employed atropine to prevent the accumulation of blood in the great veins, although those of us engaged in clinical medicine have long regarded it as one of our great aids

When Doctor Porter referred to the exposure of the patient to cold in the transfer from ward to operating room he was réminded of an incident observed many years ago in London in experimental work upon the brain of monkeys The monkeys were brought in clad in little red dressing gowns and kept warm by hot water bags Inquiring the reason for this he was told that if this were not done the monkey died of shock during the opera-In the afternoon of the same day he saw Victor Horsley remove a large brain tumor from a woman clothed only in a nightgown and lying on a one inch glass-topped operating table He wondered whether the vital resistance of the monkey and the difficulty of its maintaining heat had any bearing on human surgery The maintenance of heat on the one hand and the presence of excessive heat on the other are points all too frequently ignored We often see patients brought into the operating room with the blankets rolled up and hanging across the base of the neck, the belly exposed, with no recognition of the fact that it is the heat citadel of the body soon as the belly is opened the cold is felt there The chairman will remember that many years ago we carried on a series of experiments upon animals in which we showed that the introduction of fluids of various temperatures into the peritoneal cavity produced a most extraordinary variation in blood-pressure Fluids a little below the normal temperature of the animal caused profound drop in blood-pressure These same fluids applied to the wall of the abdomen or introduced high up in the bowel, where they circulated in the same area except that the bowel wall was between them and the peritoneal cavity, caused no variation in blood-pressure fore, according to these experiments is of considerable importance

In regard to the saline question, he was interested many years ago in

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having a demonstrator of physiology standing beside him who, when he injected a considerable quantity of fluid into the animal, expressed great surprise that the blood-pressure did not rise. There is nothing more fictitious than the idea that such injection of fluid is followed by rise of blood-pressure. You can inject three and four times the equivalent of the total amount of the blood of an animal without causing a rise in blood-pressure.

Doctor Porter did not refer to the hypertonic solutions or to the use of the viscous fluids If there is one function of the body about which it is most jealous and most cautious it is the maintenance of the normal chemical constitution of the blood If you give a man with healthy kidneys 30 grains of any potash salt three times a day he will have no symptoms, the kidney will eliminate the potash and maintain the normal condition of the blood, but if the man has renal disease the potash becomes a poison The moment you put in a pint or quart of strong bicarbonate of sodium solution, unless you are going on the principle that the symptoms are due to acidosis and that you are able to neutralize the acidosis as in a test tube by adding alkali, you are putting into the blood stream a preparation of sodium which Nature never intended should be there sonally, I believe that little will come of this new acidosis treatment in shock I do not believe that acidosis has anything to do with shock Doctor Porter said that the degree of acidosis was so small that it did not produce symptoms Doctor Hare's conception is that the individual is bleeding to death in his own vessels and that there is an accompaniment of loss of nervous equilibrium He believed that in the problem of shock there is a condition exceedingly complex in Nature in which certain factors in certain cases are dominant and in other cases other factors are dominant, and that it is not a single pathological state or a proposition as simple as we see in the consolidated lung of croupous pneumonia

DR JOHN B Roberts said that about thirty-five years ago he wrote in the first volume of "Holmes's System of Surgery" (which Doctor Packard edited in this country) on shock, and showed the similarity of symptoms of fat embolism and those of surgical shock. He had not, however, seen much reference to this fact in surgical literature, until he read what Doctor Poiter has recently written. Surgeons knew that shocked patients seemed to revive considerably under the effect of ether anæsthesia, when we formerly amputated limbs as soon as leaction seemed moderately well established. Indeed, in those earlier days hypodermic use of ether was employed to some extent as a remedy for shock. See "Holmes's System of Surgery," American edition, 1881, vol. 1, p. 145. The distinction made then was that so-called "delayed" shock might be fat embolism. May not Doctor Porter's cases have been examined by him after shock had been replaced by fat embolism?

Doctor Porter closed the discussion, saying that with the history of blood-pressure, he had noted that several times in the history of fattembolism a condition simulating shock had been seen. If, however, these

#### ADDRESS ON "SHOCK"

citations are examined it will be found that in no case is there anything like the surgical shock as seen on the field of battle. His contribution consists of a method of measuring low blood-pressure in conditions resembling shock and he had presented certain facts of which he was sure. He did not personally know about the use of gum acacia mixed with saline solution. It must be tried with caution. It is not necessary to have the blood-pressure remain up for a long time, these patients are just on the edge between life and death, if you can bring them back to life for ten minutes at a time you will probably get them through. If, therefore, you have a remedy by which you can raise the blood-pressure again and again, try it, and nurse the patient past this critical point.

With regard to opium, the surgeons in France who had seen a good deal of this condition of shock were in the habit of giving opium whenever the patient was restless. He himself believed that it was a good thing, but his experience in connection with the circulation is that it is never safe to speculate. The blood-pressure can be raised even in a normal individual by carbon dioxide inhalation. So, when he is asked to explain how it is that fat embolism produces shock he frankly says that at the present moment he had no definite information regarding it and would be incapable of offering a hypothesis

# TRANSACTIONS

OF THE

# NEW YORK SURGICAL SOCIETY

Stated Meeting, held April 10, 1918

The Vice-President, Dr William A Downes, in the Chair RECURRENT PERITONEAL ADHESIONS WITHOUT EVIDENT PERITONITIS

DR ROBERT T Morris presented a woman upon whom he operated nine years ago for fixation of the kidneys, subsequently for suspension of the uterus, and four years later did a hysterectomy for fibroid uterus patient has a congenital ptotic habit, narrow costal angles, and low colon, but at the time of removal of the uterus there was no undue inflammation There was good repair Two or three years later the patient suffered from intestinal obstruction which he considered due to the presence of adhesions, and five weeks after the onset he operated, finding a few peritoneal adhesions involving the execum only He separated these but failed to make a note at the time of the method of prevention of recurrence of adhesions used He has, however, three resources, Senn's omental graft, Cargile membrane (which some experimenters believe causes the formation of peritoncal adhesions but which he does not believe is true in the human) and aristol film In cases in which there is much oozing from the site of adhesions, the aristol film is not applicable and here he prefers the Cargile membrane aristol film makes a mechanical obstacle to recurrence of adhesions. There is a gradual disappearance of the aristol by the ordinary fatty metamorphosis of cells and in a year or two it has entirely disappeared

The patient presented did pretty well without further evidence of intestinal obstruction until November, 1917, when there was evidence of marked intestinal obstruction, operation disclosed no adhesions at the site of the former adhesions, but well up above the excum was a very strong band from the parietes surrounding the ascending colon, this was liberated Shortly after that she again had symptoms of intestinal obstruction, and on March 28, 1918, another operation disclosed most extensive adhesions involving the transverse colon, several loops of ileum, and at least thirty minutes was spent in the separation of these adhesions. Such an extensive lesion coming on without any evident peritoneal inflammatory process is considered by Doctor Morris as a most interesting condition. In several similar cases he has attempted to discover if the adhesions were due to toxins or to parenteral bacteria, in many cases cultures showed anaërobes or the colon bacillus free as a parenteral bacterium, in other cases no results were obtained from the cultures. He is much in doubt whether such adhesions described to discover in the such adhesions were obtained from the cultures.

#### TUMOR OF THE BRAIN

sions are caused by injury to the endothelium by parenteral bacteria or by toxins excreted at elective affinity sites

DR WILLIAM A Downes did not consider it necessary to look for a bacterial cause for these adhesions but laid more importance upon the mechanical conditions arising at the time of operations, stating that in his own cases he believed the handling of the viscera by dry gauze, rough handling, and allowing the intestines to come in contact with the skin which has been painted with iodine or other antiseptics is often responsible. A minimum amount of handling, the use of wet pads, and as little trauma in every way is the thing to be desired. He considers some patients more prone to the development of adhesions than others

DR WILLY MEYER called attention to a method of treatment not sufficiently practised, that is, in such cases where we apprehend the formation of adhesions, particularly after the removal of tumors, and raw surfaces that cannot be covered with peritoneum remain behind. It has been found of value in such cases to place the patient soon after the wound has closed in a frame with electric lights regularly every day or every other day for from half an hour to an hour, making use of the superheated air

DR R T Morris, in closing, stated that the points called attention to by Doctor Downes were well made, but he has frequently said the same thing, he is very careful not to allow any iodine to get into the peritoneal cavity, since finding in experiments with rabbits that carelessness in this regard was productive of iodine adhesions. In regard to handling the viscera he is extremely particular, and in the case reported the most extensive adhesions occurred in parts of the bowel that had not been touched previously

# SUBOCCIPITAL DECOMPRESSION FOR TUMOR OF THE BRAIN

DR Seward Erdman presented a boy of thirteen years who was admitted to the New York Hospital, on February 8, 1918, with the complaint of occipital headache of five weeks' duration increasing in severity and with occasional vomiting for three weeks previous to admission. In his previous history there was little to throw any light on this condition Family history negative His left leg was injured by a carriage wheel two years ago No history of injury to the skull Without any preceding trauma, or middle ear disease, about the first of January he began to have occipital headaches, at first slight, then very severe Three weeks before admission he vomited on three successive days, once each day For the past two weeks he has done very poorly at school, although previously bright. Is very nervous and unable to keep arms and face still. His severe headache interfered with sleep While in the medical ward, where he stayed for four weeks, the case was thoroughly considered and a number of tests were made Von Pirquet and the Morro tests were negative His blood Wassermann was negative and spinal fluid, of which 15 cc were removed, showed a pressure supporting a nine-inch column of mercury, there were nine white bloodcells, 77 per cent lymphocytes, spinal fluid Wassermann negative

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spinal fluid was injected into a guinea-pig and showed no evidence of tuber-Examination upon admission, February 8, 1918, showed occasional movements of the muscles of the forehead with lifting of the eyebrows Knee-jerks were not elicited, there was no Babinski reflex and no ankle clonus Slight enlargement of lymphatic nodes An X-ray of the skull (anteroposterior view) showed a slight clouding of the right maxillary antrum suggestive of a sinusitis, but there was nothing about the past history or in the examination of the nose or throat to throw any light on this condition On admission his leucocyte count was 15,700, with 85 per cent February 21st, white blood-cells 11,800, 82 per cent polypolynuclears nuclears On February 16th, ten days after admission, Dr I Ramsey Hunt stated that "the character of the headache is suggestive of organic lesion in the posterior fossa. There is beginning slight optic neuritis. Gait uncertain, especially on turning No spontaneous lack of coordination as in passpointing and no adiadokokinesis, no nystagmus" On this same date Dr Colman W Cutler found a "slight papillary œdema involving the nasal part of both discs More marked on left Elevation of two diopters" The patient continued to complain of severe pain in the back of the neck and slept only For two weeks after admission, he vomited once or twice with medication a day and complained of extreme dizziness when his head was raised February 20th, Doctor Cutler examined him again and found swelling of the right disc, 3 D, with flame-shaped hemorrhages and left disc 2 D February 23rd, there was no change in the eye grounds On the 28th "swelling of the disc had not increased in either eye, but choked disc was more marked and hemorrhages were more numerous" In view of the fact that the patient was not improving under medication with iodides and with the positive evidence of cerebropressure increasing and the damage to his optic nerve, decompression suggested itself and was performed on March 7, 1918

Suboccipital Decompression -A horizontal incision slightly curved from mastoid to mastoid was made and then a median incision. The posterior part of the foramen magnum was removed, exposing freely the posterior aspect of the cerebellar hemispheres On opening the dura there was marked bulging of the cerebellar hemispheres but no increase of fluid, the right side bulged more than the left Inspection and palpation did not reveal any tumor For about ten days following operation there was little change in the boy's mental condition, he did not vomit during this time, although he has subsequently vomited three times, he lay still in bed apparently in a great deal of pain and showed no interest in anything, having to be fed by hand Two weeks after the operation there was a marked change in his condition. he began to be interested in his surroundings, looked at pictures and books. has since read books and finally he began walking about holding on to the Doctor Cutler examined his eyes again on March 23rd, sixteen days after operation, and found that the "elevation of the nerve in both eyes was not measurable The upper nasal edge was slightly blurred Vestiges

#### LUETIC OSTEOMYELITIS OF THE ULNA

of hemorrhage noted along nerves with exudate more marked on right side" His gait was still somewhat unsteady but not ataxic. His dizziness continued for four or five days after he was up. Although tumor of the cerebellum was not verified at the operation, his improvement following the suboccipital decompression has been so striking that the case seemed worthy of presentation

There is at present slight bulging in the suboccipital region with well marked pulsation

DR ALTRED S TAYLOR stated that sometimes a deep cyst would give physical signs as described in this case and one cannot be sure by palpation alone whether or not such a condition exists. He suggests a blunt exploring needle to determine this point. With regard to the incision he considered it of interest that Doctor Erdman had used the crossbow incision when he had a median incision, stating that in a boy like this with a long thin neck one can get good exposure without the median incision and this would save a considerable amount of time and bleeding. In many cases he considers it wise to make the curved part of the incision with the removal of muscles over the occipital bone, and if one then does not have sufficient room to expose the cerebellum properly the median part of the crossbow can be made

#### LUETIC OSTEOMYELITIS OF THE ULNA

DR J M HITZROT showed a young woman, aged twenty-two years, who was admitted to the New York Hospital on March 21, 1917, for a luetic condition of the left ulna She contracted lues about two years ago and was not treated She injured the left arm by a fall from a horse one year ago, and fell again in December, 1916, at which time a swelling appeared near the elbow, and the arm has since been painful and useless. On her admission to Doctor Kent's clinic she had a gumma over the olecranon which was discharging and which exposed the bone. There was a fracture of the middle of the shaft of the ulna which the X-1ay showed to be pathological. Wassermann positive. From March 28th to May 28th, she had nine injections of diarsenol, two of 0.3 mgm, and the others of 0.4 mgm, without any effect upon the bone.

On June 5, 1917, the ulna was excised from the olecranon down to within one inch of the head, leaving the periosteum which could only be distinguished as a structure on the anterior surface of the bone. The bone was completely necrotic, moth eaten, cheesy-white in appearance, and did not bleed except at the upper and lower ends. The exposure of what seemed normal bone was then made at each end, and a tube of connective tissue with periosteum on one face was made by running catgut stitch with the ends of the bone at each end of the tube. She made an uneventful recovery, but showed no signs of bone regeneration, and eleven weeks after the first operation, 1e, on August 17, 1917, the two ends of the ulna were exposed by a long incision through the scar of the ulnar bed, exposing the upper and lower ends of the ulna. A groove was then cut in both ends exposing

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the medulla and a wedge-shaped graft nine inches long and about one-half inch wide was then cut from the left tibia with the Kenyon saw. The graft had periosteum and endosteum. The graft was then placed in the grooves previously formed and fastened in position by kangaroo tendon ligatures at each end. The muscles, planes and skin were closed about the graft with interrupted sutures without drainage and the arm put up in a sugartong moulded plaster splint.

She made an uneventful recovery and the splint was removed in a little over nine weeks, the arm then being solid. The X-rays show the graft anchored at each end and the last X-ray, January, 1918, six months, shows the beginning enlargement of the central portion of the graft. Since her operation, she had had several doses of diarsenol and during her convalescence the region of the wound was treated with 30 per cent calomel outment.

#### ABSCESS OF THE LIVER

DR FORBES HAWKES presented a man, twenty-four years of age, who, seven and a half weeks ago, was taken with fever and malaise and went to bed He ran a temperature of 101-102° F and pulse-rate of 80-100 His Widal was negative and there were no malarial organisms found in the blood About one week later he developed some pain in the right side, under the ribs anteriorly, and some râles were heard above the gall-bladder region, over the liver The pain was variable but fairly persistent. He had no chill Leucocyte count, 14,000, 79 per cent polymorphonuclears, and he was constipated His temperature then gradually went down to normal and he took a trip to the Adirondacks to get braced up While away he was fairly comfortable but had some pain in the right side at times His pain then became more pronounced and his temperature reached 102° F by mouth, pulse-rate 90 He looked a little flushed His liver seemed somewhat enlarged and tender to the right side of the midline in the epigastrium He had some right upper abdominal rigidity An X-ray of his gall-bladder region was negative as to calculi A Wassermann was also negative The urine showed a few casts and some red blood-cells He went into the Nassau Hospital in Mineola one week later An exploratory incision was made over the gall-bladder region The gall-bladder and anterior portion of the liver were normal The portion of the liver directly above the right kidney was found to be enlarged and there were a few slender adhesions of the posterior edge of the liver to the posterior peritoneum. The adhesive process had not progressed sufficiently to make it a safe procedure to open the abscess at that time, so a gauze strip was passed down to this area just above the right kidney and brought out through a stab-wound in the right loin The anterior wound was closed Five days later this stab-wound was enlarged anteriorly, and the upper pole of the right kidney located by the finger and pushed anteriorly out of the way The bulging liver was then felt and the abscess opened with the finger About six ounces of

#### UMBILICAL HERNIA

yellowish, sticky pus, with no distinct odor, were evacuated. Fenestrated rubber tube drainage was used. The peritoneum was not opened in this second operation. The patient made an excellent recovery, draining profusely. He healed up solidly in about six weeks. He has remained well since then. The cultures of the pus showed "Staphylococcus aureus" (Sondern Lab.). In looking back for some cause for the abscess, the only thing that could be considered as a possible factor was the fact that in his work he often lifted the rear end of an automobile, supporting the frame against his right side. It is possible that he may have traumatized his liver in this way.

# CARCINOMA OF THE RECTUM

DR FORBES HAWKES presented a man, forty-five years of age, from whom he had removed a carcinoma of the rectum seven years and nine months previously An almost annular carcinoma was found about 21/2 inches from the sphincter The so-called combined operation was performed as follows Through the lower abdomen the rectum and sigmoid were detached from the bladder and posterior pelvic attachments up to the promontory of the sacrum and the abdominal wound temporarily closed. An incision was then made slightly to the right side from the anus to just above the level of the sacrococcygeal joint. The attachments of the coccyx on the right side were divided and the sacrococcygeal joint opened and the coccyx reflected to the left Through this opening the lower rectum was mobilized, the lateral vessels being clamped and tied Large clamps were then applied to the bowel about two inches above and below the growth and this portion The bowel ends were united, end-to-end, by suture, and gauze drainage inserted The abdominal wound was reopened and some oozing found from the raw surfaces in the pelvis, necessitating the placing of a small cigarette drain The patient made an excellent recovery except for the establishment of a small fecal fistula in the lower part of the posterior wound which has persisted to the present time but which interferes very little with his work. He passes some gas through it at times but no fæces unless he He keeps his bowels in good condition by taking an enema has a diarrhœa every night after his work is done and this way he has no trouble when he is on the stage The anastomosis scar is a linear one without any evidence of recurrence and the patient is up to his usual weight. The pathological report on the tumor was "Adenocarcinoma—glands not involved"

# UMBILICAL HERNIA THE CONDEMIN-RANSOHOFF TECHNIC

DR H B DELATOUR read a paper with the above title, for which see page 732, lxvii (June, 1918)

DR WILLIAM B COLEY said that at the Hospital for Ruptured and Crippled from 1891 to 1918 there were 162 cases of umbilical hernia operated upon, 58 in children, with no relapse, 104 adults with 3 relapses The Mayo

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operation was done in 77 cases with one relapse and in 34 cases the vertical overlapping method with two relapses He considered that there was no harder operation in surgery than that for strangulated umbilical hernia presenting a mass of omentum or intestine which it is impossible to unravel or to separate the adhesions, and he believes that the plan advocated by Bloodgood of doing a two-stage operation is good He stated that a few cases which had proved fatal in his hands he thought might have had a different result had the two-stage method been used In most of the nonstrangulated cases with judicious care the adhesions can be separated and the contents reduced In closing such wounds he strongly opposed the use of silkworm-gut, silver wire or any form of non-absorbable suture stated that in the early days when there was more or less uncertainty as to the possibility of properly sterilizing absorbable sutures, there might have been some justification for the use of non-absorbable sutures, but at the present time there was none He stated that kangaroo tendon or chromic gut remains unabsorbed sufficiently long to fulfil all the requirements of the radical cure of all types of hernia

With regard to the use of silver filigiee or silver wire in umbilical or ventral hernia, he pointed out its many disadvantages and expressed the belief that better results could be obtained with kangaroo tendon

DR WILLY MEYER in commenting upon the value of the Mayo technic in the radical operation for umbilical hernia referred to the procedures of the past before its introduction where in many instances poor results were obtained He then viewed the various technic up to the present time and stated that he had used the silver filigree with great satisfaction in a number of cases, he does not unravel the contents of the sac but reduces them en masse, placing on top a silver filigree He has, however, abandoned this method after an unpleasant experience. In fastening the filigree with silver wire sutures he caught inadvertently the wall of a loop of intestine Ten days later a fecal fistula occurred which was a source of great trouble He feels, however, that certain types of cases are still best treated by the filigree, particularly after resection of the abdominal wall for tumor. It is the only method to prevent formation of a hernia, it should be made during the operation He considers the Mayo technic a tremendous advance upon former methods Regarding strangulated herma of the type mentioned in the paper they are frequently dangerous, becoming gangrenous in a remarkably short time He cited an instance of a patient with a long-standing hernia which had become irreducible and which suddenly became strangulated, there was no vomiting and a physician was not called for twelve hours At this time she was promptly removed to the hospital and operated on, the entire amount of small intestines which was strangulated was totally gangrenous and resection was necessary, this patient made a good recovery, had there been any further delay she would doubtless have succumbed

With regard to the opening of the sac he believed the majority of surgeons made a transverse incision of the sac about one-quarter of an inch

#### UMBILICAL HERNIA

above the surface of the abdominal wall, after having thoroughly exposed the fascia around the umbilicus. This transverse incision of the sac close to the umbilical ring usually exposes these parts in such a way that repair is easy.

DR James M Hitzrot cited one experience in connection with opening of the sac as recommended. This was a case occurring two years ago at the New York Hospital in an Italian woman of thirty-seven, who had been sick for twenty-four hours. She had had a big umbilical hernia for a great many years. The symptoms resembled an intestinal obstruction and were considered as due to strangulation in the hernial sac, but on opening the sac, a gangrenous appendix was found to be the cause of the trouble. This appendix and the gangrenous omentum were removed and the wound closed without drainage. Except for a slight wound infection in the skin, she recovered promptly. The wound was closed as in a radical cure

DR WILLIAM A DOWNES stated that he had had two cases of strangulation of umbilical hernia due to bands within the hernia sac, one in an old lady in poor condition, where he simply opened the sac, liberating the band, leaving the hernia in situ, in the other he opened the intestine, drained it, and closed it later He considered that some cases must be treated conservatively, especially when the patients are in poor condition

DOCTOR DELATOUR, in closing, stated that he had had a large number of cases of strangulated umbilical hernia and since using the Condemin-Ransohoff method his mortality had become practically ml He feels much more confidence in this method than he ever did in any other used by him He agreed with Doctor Downes that with a patient in poor condition milder treatment might be justified, but in cases of bands within the sac as mentioned by him he thought it possible to find trouble here. He does not approve of the artificial anus, as it leaves a gangrenous mass in the sac After the sac is lifted up the intestine is in full view and if loose can be easily withdrawn, the neck of the sac is divided, giving free access the intestine is gangrenous no attempt at withdrawal is made but immediate resection is done. The incision should be made internal to the ring which is a simple procedure and is a time saver. In a number of cases where he found a fairly large mass of intestine not gangrenous but adherent and looking as though there was obstruction he has not felt justified in taking time to straighten out the bowel, but replaced it in the abdomen on the theory that previous to the obstructive symptoms the intestine had been in that condition, and in none of these cases has he had further trouble states that the Condemin-Ransohoff method leaves the wound in condition for a Mayo closure He was prompted to bring this matter before the profession again as he had recently seen a strangulated hernia attacked in the old way, an hour being spent in an attempt to release the contents of the sac, while by this method the whole operation of freeing the intestine and omentum could have been done in fifteen or twenty minutes

In reply to Doctor Downes' query he stated that in every case he would

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open the sac, dividing the ring, and proceed according to the character of the intestine found. If the gut looks viable and responds to stimulation it should be left, otherwise resection is indicated.

# Stated Meeting, held April 24, 1918 WILLIAM A DOWNES, M D, Vice-President, in the Chair EFFECT OF ELECTROMAGNET ON SCAR TISSUE

DR W C Lusk presented six cases treated with the electromagnet radiator of E K Muller in the treatment of painful or tender scar tissue and stiff joints following immobilization These cases form the basis of a paper to be published later

#### MYELOMA OF THE CLAVICLE

DR J M HITZROT presented a man, forty years of age, who in January, 1917, sustained a fracture of the right clavicle. Nine months later, the patient noticed a small lump at the attachment of the sternomastoid muscle, a second lump appeared three weeks later at the point of fracture in the clavicle, and this had been growing slowly He also noticed a small lump on the pectoral border in the axilla, which apparently had no relation to the other two masses The only inconvenience noted was the fact that his collar became too tight The patient was admitted to the New York Hospital on February 20, 1918, at which time there was a tumor in the region of the lymph-nodes just behind the attachment of the sternomastoid and one in the posterior triangle His blood Wassermann was negative, there was no indication of these masses being tubercular and it was indefinite as to whether or not they were related to the fracture At operation the incision was carried along the clavicle, cutting the sternomastoid muscle, and exposed a rather curious tumor, totally encapsulated, looking much like an hypertrophied lymph-node This was removed and then the second mass, which was fixed to the under surface of the clavicle, was found to spring from the medulla, the cortex being entirely destroyed, for this reason it was thought that this lump had its origin in the medullary cavity The clavicle was therefore The patient made an uneventful recovery

Histological examination showed the tumor to belong to that curious type of tumors named myeloma, it was a plasma-cell tumor, and these are very uncommon. A section of the tumor showed the characteristic cellular picture and excentric nucleus staining deeply with deeply staining cytoplasm resembling the plasma cell of Unna. The small lump at the pectoral border which was increasing in size proved to be a lipoma. The sternomastoid muscle where it was fastened to the pectoral became contracted and a piece of tissue of both pectoral and sternomastoid muscles was removed, but there was no evidence of recurrence of the first tumor.

Vance presented a paper on multiple myelomata in the American Journal for Medical Sciences, in 1916, in which he divided these tumors into five groups, of which he makes the fifth group the plasma cytoma and gives the

# MYELOMA OF THE CLAVICLE

literature in these cases They are not common and outside of their histological picture they are not yet definitely classified

The patient presented was given five X-ray treatments after the operation, at Doctor Ewing's suggestion, on the supposition that the X-ray is beneficial in preventing the recurrence of cellular tumors of this type Whether or not his fracture was the cause of this tumor of the clavicle which occurred at the point of fracture nine months later is still a question

DR WILLIAM B COLEY expressed it as his opinion that the injury might be considered the causative factor of the tumor, and stated that he had observed eight cases of sarcoma of the clavicle in two of which he performed total excision In one case operated upon nine years ago there was a rapidly growing round-celled periosteal sarcoma following a severe strain from This case was treated with the mixed toxins of sliding down the banister erysipelas and bacillus prodigiosus for five months, following total excision of the clavicle, and there has been no recurrence. He recently saw the patient and had planned to show him at the meeting this evening, but was unable to do so, as he had joined the Aviation Corps, and had left New York At the present time the patient has perfect functional use of the arm then mentioned another case of total excision of the clavicle in a boy eight or nine years old, operated upon by him some seven years ago for roundcelled periosteal sarcoma in which the same line of treatment was followed but in which a recurrence developed in two months, and, although the patient was treated by Doctor Abbe, with radium, he died in five months from the time of the original injury. The tumor in this case occurred two weeks after a fall, striking on the end of a wooden box

Doctor Coley also referred to several moperable cases and to some treated originally by other surgeons than himself. Among these was a case in which the entire clavicle was excised by Dr. Maurice H. Richardson for round-celled periosteal sarcoma, in May, 1908. Immediately after the operation the patient was referred to Doctor Coley for toxin treatment, which was started in New York and continued later at home. At the time the treatment was begun there was considerable infiltration of the whole lower cervical region suggesting a recurrence or incomplete removal. The condition entirely cleared up during the next two months. The toxins were continued for nearly six months by the family physician, Doctor Trulock, of Dixmont Maine. The patient is still well at the present time, nearly ten years after the operation.

Doctor Coley had personal notes from Dr Thos W Huntington, of San Francisco, of another case of total excision of the clavicle for a periosteal round-celled sai coma of the clavicle, in which the toxins were given for five months as a prophylactic, and the patient is still well, ten years later

At the time of publication of his paper on "Sarcoma of the Clavicle End Results Following Total Excision," in 1910, Doctor Coley was able to collect from the literature only 64 cases of total excision of the clavicle for malignant disease Previous to 1893 there had been reported only 32 cases,

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just two of which had remained alive and well beyond two years. In view of this fact Doctor Coley believed it fair to assume that the use of the mixed toxins as a prophylactic in the cases described played some part in preventing a recurrence of the disease.

#### DUODENOJEJUNOSTOMY

DR WILLIAM A Downes presented a young woman, 21 years old, who was admitted to St Luke's Hospital, March 23, 1918, with a history that for the past year she had suffered from attacks of vomiting, coming on about three times a day, the vomiting has no relation to meals. She has had several attacks at night, there has been no blood in the vomitus, she has no acute pain, but at times has gastric distress which is relieved by vomiting, this distress is made worse by taking soda and food, has had no tarry stools, no jaundice. She was poorly developed and nourished, with opacity of both corneæ. X-ray shows large six-hour retention with enormous dilatation of the first and second portions of duodenum.

Operation (April 1, 1918) — Duodenojejunostomy

Pathological Findings—The first and second parts of the duodenum were very much dilated, being almost the same diameter as the stomach, there was a hard mass of glands at the head of the pancreas causing obstruction of the duodenum Pathological report of these glands tuberculous

The patient gained seven pounds in weight before leaving the hospital, and has continued to gain since. Vomiting entirely relieved and is able to take and digest all sorts of food.

Doctor Downes stated that the only cases of duodenojejunostomy of which he had been able to find a record were one by Doctor Stavely, of Washington, done for dilatation of the duodenum and one performed by Doctor Beckman for giant duodenum

DR WILLY MEYER stated that he had lately operated on a patient with all the clinical symptoms of pyloric obstruction which were corroborated by the X-ray which showed that the patient's stomach had remained filled instead of emptying. Operation disclosed a foreign body in the duodenum, which was found, on opening the intestine, to be a fruit pit. In the lower third of duodenum there was an obstruction due to a tumor of the head of the pancreas which had grown forward, stricturing the lumen. In suturing the small wound in the duodenum Doctor Meyer found the wall very friable and this in conjunction with other experiences leads him to the conclusion that the duodenum when distended is more brittle than other parts of the bowel. For the relief of the condition found in this case he performed a posterior gastro-enterostomy. The patient died suddenly thirty-six hours later, supposedly from perforation, but the autopsy failed to show this and death was therefore ascribed to his markedly debilitated condition

#### GASTROCOLIC FISTULA FOLLOWING GASTRO-ENTEROSTOMY

# GASTROCOLIC FISTULA FOLLOWING GASTRO-ENTEROSTOMY

DR WILLIAM A Downes presented a man, thirty-three years of age, who was admitted to St Luke's Hospital, February 15, 1918 In June, 1913, he began to have pain and tenderness in abdomen, and in July, 1913, was operated on for chronic appendicitis About two or three weeks later the pain returned as before In the summer and fall, 1913, he had two periods of medical treatment of two weeks each for duodenal ulcer recurrence of pain afterward In December, 1913, he was subjected to a posterior gastro-enterostomy, and pyloric occlusion. Did not improve, could not retain food, lost eighteen pounds in weight On January 28, 1914, a second operation by the same surgeon X-ray had shown the gastro-enterostomy opening closed This was enlarged Symptoms continued off and Various medical treatments, or treatments for temporary relief were November 6, 1914, his abdomen was again opened and a large ulcer was found at the artificial opening, this was excised, and the gastro-enterostomy done again Patient was in bad condition, the gastro-enterostomy was done, therefore, by means of a Murphy button, patient's life was at a very low ebb for several days following this operation, and convalescence was slow In January, 1915, the old pains had returned He was treated by diet and rest, but without much success

During 1915 he had three serious hemorrhages into his bowels. In February, 1916, he was put upon a careful medical treatment of diet and alkalies with rest, and immediately began to improve. His pain left the second day of treatment and he began to gain weight rapidly so that within three months he had gained thirty pounds and returned to work shortly after this. Except for occasional bowel disturbances in the shape of diarrhæa he was entirely without symptoms until the summer of 1917, eighteen months later. He had continued the careful medical treatment with alkalies and diet over a full year, during the last few months of which it was less rigorous but still ample to control the acidity in the stomach. Off and on during October and November, 1917, he had attacks of diarrhæa. He had no pain with these. They were simply quick evacuations of the bowels with watery movements. In December, 1917, he first noticed the belching of an ill-smelling gas at times and an occasional nausea. But he had no vomiting

In January, 1918, he had an attack of vomiting one evening and noted fecal material in the vomitus. This was corroborated by his physician. For a day or two he would have no trouble, and then for several days would have diarrhea and occasional vomiting of fecal material. X-rays were taken and showed within an hour that bismuth was in the transverse colon after ingestion in the stomach, and later a bismuth rectal injection showed bismuth in the stomach within an hour. The diagnosis of fistula between the stomach and colon, either direct or indirect, was thus corroborated, and he was operated upon February 15, 1918. Examination showed that transverse colon had become adherent to the gastrojejunal cicatrix and had sloughed

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through The area of anastomosis was delivered into the wound, the communication between the colon and stomach determined, the colon stripped off the site of the anastomosis by blunt scissors dissection, and the rent in the colon repaired by three tiers of Lembert sutures, the gastro-enterostomy opening enlarged and repaired in the usual manner by three layers of Lembert stitches, the wound closed in layers about a rubber dam drain to the site of the anastomosis. The patient recovered without drawback and in less than three months has gained forty pounds in weight

DR JOHN ERDMANN stated that he had had a duplicate of the case reported, in a man twenty-six years of age, who was operated on for duodenal ulcer three years ago, having a pylorectomy with the gastro-enterostomy Subsequent to operation he had excruciating pains in the left lower abdomen, and, seeking relief for this, he traveled from the Eastern to the Western coast, to Rochester, visited several sanitaria, and finally consented to Doctor Erdmann's doing an exploiatory operation a year ago, when an anastomosis between the transverse colon, the duodenum, and the stomach was found Doctor Erdmann suggested that this fistula might have been caused by the suigeon in taking the stitch between the transverse mesocolon and the stomach, putting his stitch through the colon. It was an interesting point that the persistent pain mentioned ceased immediately after closure of the fistula and enlarging of the gastro-enterostomy opening. This patient is now in good health and serving in France in the Aviation Corps

#### COLOPEXY FOR PROLAPSE OF THE RECTUM

DR WILLY MEYER presented a woman, aged twenty years, who had developed prolapse of the rectum during the past two years The prolapse was 21/2 inches long and appeared with each defecation. According to the nomenclature of Moschcowitz, it would be considered an incomplete pro-In this case Doctor Meyer made the McBurney incision, opened the peritoneal cavity parallel with the skin incision as wide as the intermuscular incision would permit, and placed the patient in the exaggerated Trendelenburg position in order to pull up sigmoid and rectum, put the latter well on the stretch He then rubbed the parietal peritoneum and the gut with dry gauze and attached the lowest end of the sigmoid to the peritoneal incision with silk threads, closing the opening The patient made an uninterrupted recovery and since the operation on February 25 of this year has had no further trouble Doctor Meyer is not certain of a cure in this case and will watch the case with interest However, he would be surprised to see it return, since he firmly anchored the sigmoid with the five silk sutures stated that in a large prolapse he would adhere closely to the Moschcowitz operation

DR W C Lusk said that he had seen two cases of prolapse of the rectum associated with loss in weight, one of them being greatly emaciated, in both of whom, with the restoration of normal body weight, the replaced prolapse finally remained in position

#### GASTROGASTROSTOMY FOR HOUR-GLASS STOMACH

# POSTERIOR GASTRO-ENTEROSTOMY FOR GASTROPTOSIS

DR WILLY MEYER presented a woman, twenty-nine years of age, who had had stomach trouble for years, fermentation, pain, constipation, headache She was very nervous and had lost steadily in weight She had general enteroptosis, and particularly was the stomach affected, the greater curvature had sunk into the pelvis and formed a "water-trap stomach" According to the literature on such cases, any efforts at attachment by stitching the stomach are not encouraging. Doctor Meyer in this case decided to do a typical posterior gastro-enterostomy and to close the pylorus absolutely. He stated that he made use of Hueltl's wire stitching instrument which he considered particularly adapted to cases like this. The patient made a good recovery and since then has been but little troubled by her digestion, although she still must eat with care. Before the operation she was constipated, but since then her bowel evacuations have been spontaneous and normal. She has gained in weight

#### GASTROGASTROSTOMY FOR HOUR-GLASS STOMACH

DR WILLY MEYER presented a woman about thirty years of age who had been sick for many years. There had been frequent hæmatemesis in the beginning, but this had stopped, and she had persistent gastric pain which was not dependent on the ingestion of food. There were frequent vomiting In December, 1915, she again had persistent vomiting with increasing pain, an examination of X-rays taken two years previously showed a most typical hour-glass stomach A month later Doctor Meyer operated upon her, making a transverse incision. As she had a very sharply rising angle of the ribs and adhesions within the abdomen with contraction of the cicatricial bands toward the left particularly, it was absolutely impossible to pull the stomach forward sufficiently Although Doctor Meyer would have preferred to add a longitudinal median incision, he considered it wisest to cut down in the median line to the peritoneum only and now had very satisfac-Here he found bands to both right and left and so many firm adhesions were present that he decided nothing short of an osteoplastic resection of the left costal arch would permit of proper operative procedure patient, however, was in a reduced condition. As it was found impossible to place clamps to do a gastro-enterostomy, he used the Murphy button for gastrogastrostomy The button was then covered with a running suture One stitch tore, perforating the stomach, he was compelled to stitch the proximal part of the stomach over this perforation, covering at with an omental flap The patient made a good recovery, staying several weeks in the hospital to recuperate, during which time her pains entirely disappeared and she was able to eat anything without distress. She gained there quickly six pounds in weight Previous to operation this patient had been constipated, but now has normal evacuations She is able to do the work in a hard clerical position and no longer is conscious of her stomach

DR JOHN ROGERS stated that about two weeks ago he had a case with

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a much distended stomach in which there was no vomiting but absolute constipation. When an attempt was made to pass a stomach tube it was found impossible and an area of tympanitic distention suggested a definite obstruction in the duodenum. Exploration showed this to be an hour-glass stomach with a tight cicatricial stricture about two inches from the pylorus and a rotation of the stomach so that the œsophagus was also obstructed. In this case posterior gastro-enterostomy was found very difficult but was performed without clamps by the anterior method and with a perfect result. A gastrogastrostomy would have been impossible. After the contents of the stomach had been allowed to drain into the jejunum, the œsophageal obstruction was found due to a rotation of the stomach forward to the right

#### INTRA-INTESTINAL FIBROMA

DR WILLY MEYER presented a man who came under his attention on March 2, 1918, in a condition of profound secondary anæmia following profuse intestinal hemorrhages He is thirty-four years of age On examination in the region of the cæcum a ballotting mass was discovered For several days it was not felt again and careful examinations made of the patient were all of no avail The X-rays showed nothing. There was some blood in the stool, however Patient then had another hemorrhage and once more the small ballotting tumor was found in the right side A right rectus incision was made As soon as the abdomen was opened and the intestines pulled up there was found, six or seven inches from the cæcum, a tumor opposite the mesenteric attachment, this tumor was very vascular and had not interfered with the lumen of the intestine. The appendix was removed and the gut resected, then doing an ileocolostomy by lateral anastomosis The patient made a good recovery and has had no further hemorrhage Examination of the tumor proved it to be a very vascular fibroma without ulceration, and the question arises whether or not it could have been the cause of the profuse hemorrhages Doctor Meyer believes that it was responsible, probably due to surface bleeding from the mucosa

Doctor Meyer then showed a specimen from a somewhat similar case which had been under his care previously. This patient suffered from repeated attacks of intestinal obstruction. X-rays disclosed nothing. However, there was found a resistance occurring in various portions of the abdomen at different times and the patient complained of pain in the areas corresponding to this resistant mass. Operation disclosed an intussusception in the jejunum and on reduction of this there was found a typical intraintestinal tumor. In looking over the mesentery a number of glands were found at its base and resection was performed. This necessitated the removal of a large amount of bowel. A lateral anastomosis was done and the patient made an excellent surgical recovery. Two days later, however, he developed pneumonia to which he succumbed within three weeks. Examination of the tumor mass proved it to be a fibroma.

DR WILLIAM B COLEY stated that in his opinion some fibromas are

#### TOTAL EXCISION OF BOTH PECTORAL MUSCLES

extremely vascular He referred to a patient under his care suffering with a large tumor of the ileum in which, at exploratory operation, a wedge-shaped piece 1½ inches long and 1 inch deep was excised and showed a typical pure fibroma. The tumor then began to produce a very rapidly fungating mass at the site of the wound, and in two weeks this mass was as large as a goose-egg and there were several severe hemorrhages. A large fungating tumor was removed after exploratory operation and careful examination of the larger tumor showed in addition to the structure of fibrosarcoma certain areas much more cellular and undoubtedly of malignant nature—a type of fibrosarcoma

#### TOTAL EXCISION OF BOTH PECTORAL MUSCLES IN OPERATIONS FOR CANCER OF THE BREAST

DR WILLY MEYER read a paper with the above title, for which see page 17 DR JOHN F ERDMANN stated that he would have to place himself in the list of those who did not remove all the pectoralis major and not the pectoralis minor once in ten times He stated that he had given this matter much study in the way of following his patients and that he had never seen a metastasis occur in the portions left of the major or minor pectoralis in over twentyfive years' practice unless the muscle, that is the pectoralis major, was already involved at the time of removal of the breast. Those metastases which he has found have been osseous, with the exception of shotting of the skin or possibly a metastasis occurring in a gland left in the axilla He also stated that in considering cases coming to him originally operated upon by other surgeons he could not recall a single case in which the metastasis had occurred in the portion of muscle remaining. He stated that he had seen Doctor Meyer do this operation many times and had as frequently heard him say that he left a portion of the pectoralis minor as a stump on which to graft the skin

DR FRANZ Torek stated that he had time and again found a number of affected glands under the pectoralis minor muscle of such character that they would not have been discovered or suspected unless the pectoralis minor had been removed, and quite apart from the question whether or not the pectoralis minor might be affected, he considered this a strong indication of the advisability of always removing the pectoralis minor muscle, otherwise there is a certain portion of the gland chain running along the vessels that cannot be thoroughly exposed. He said that he had seen one case in which a stump of the pectoralis major left behind by another surgeon at its insertion into the humerus was the seat of a recurrence. This one case has proved to him that even a remnant of the pectoralis major where it is attached to the humerus may be a menace, and he is therefore a strong advocate, not only of partial but of extensive removal of both pectoral muscles

DR DEAN LEWIS, of Chicago (by invitation), stated that he considered Doctor Meyer's paper well timed in view of a tendency during the last few years to recommend operations in cases of cancer of the breast which are

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incomplete These incomplete operations are followed by a greater number of and quicker recurrences This statement applies particularly to the use of a part of the pectoralis major muscle as a flap to cover vessels, with the idea of preventing cedema of the arm and limitation of motion complete operation without removal of the muscles is based on the statement of Bryant, of London, that he had never seen recurrence in the pectoralis major when the fascia covering it had been removed Doctor Lewis considered this to be a fallacy In all cases of carcinoma of the breast he advocated the removal of the sternal part of the pectoralis major and stated that the pectoralis minor muscle should always be removed, if a complete dissection in the axilla is to be made, because of the frequency with which Rotter's lymph-nodes are found He stated that the loss of motion in the arm is due to a poorly planned flap and that in all cases good motion can be secured by making an axillary flap in cases of carcinoma of the breast. He again referred with regret to the fact that during the past few years some of the surgeons in the Middle West have been led to do incomplete operations on the advice of using the pectoralis major muscle as a flap to restore function of the arm

DR WILLY MEYER, in closing, stated that in regard to Doctor Erdmann's remarks, he had never seen a recurrence in the muscle, and he considered this question not at stake. His point was that entering between the two portions of the pectoralis major may mean to invite cancer infection and that the lymphatic vessels filled with cancer cells when opened, may carry the cancer to distant fields with metastases occurring far from the original focus. He is fully convinced that a certain number of metastases are directly invited by entering between the pectoralis major and minor muscles.

Relative to Doctor Erdmann's remark that he, Doctor Meyer, had frequently left a stump of the pectoralis minor muscle for skin-grafting purposes, this he acknowledged to be correct. What he left behind, however, was a stump of about 1/4 inch attached directly to the ribs. It has been shown by many observations that primary cancer has never been found in the pectoralis minor muscle except in very advanced cases. Since the Handley addition enables formation of two large flaps, which usually can be closed by sutures, it is no longer justifiable, in Doctor Meyer's opinion, to leave a stump of any one of the two muscles behind

Stated Meeting, held May 8, 1918
Wm A Downes, MD, Vice-President, in the Chair
LARGE STRANGULATED VENTRAL HERNIA

DR SETH MILLIKEN, JR, presented a woman, seventy-five years of age, who was admitted to Lincoln Hospital, June 5, 1917, with a large postoperative ventral hernia following a myomectomy in 1906. In 1910 she was admitted to hospital with vomiting and abdominal distention, which, according to her report, was ptomaine poisoning. She had a good deal of trouble for a couple of weeks but under treatment was able to go

#### SELF-INFLICTED INJURIES

home, and until the date of admission had been practically a chair patient because of the large abdominal mass which made walking practically im-On admission she gave a history of severe pain and vomiting and straining without being able to move her bowels after the first effort Under local anæsthesia of ½ per cent novocaine with adrenalin a large incision was made, vertically, excising the former scar A strangulated hernia, of which the intestine was not gangrenous, was released by opening below, as that was the only free margin of the sac The sac consisted of three large pockets, the most superficial was below and was in the fat and easily freed, that did not release the obstruction, the next gut that was released was from a pocket extending three inches to the left and which had a wide open neck that was not constricted. Then dissecting down through trabeculated fat with a good deal of difficulty a small ring was found extending to the right through which the finger tip could barely On division of this ring the constricted gut was released and was found viable. The patient had no pain, the operation consumed fifty-five minutes, and when the gut was released the contents were reduced and the margins of the ring were approximated without special effort at overlapping Chromic gut was used for the deep layer an uncomplicated recovery and was out of the hospital within three weeks and has been perfectly well ever since In November, 1917, she was able to visit her brother for the first time since 1910 She wears a corset which gives enough support and there is no evident hernia now, there is, however, a very relaxed abdominal wall

Doctor Milliken presented a second case, a woman aged fifty-seven years, who for nineteen years had had a very large umbilical hernia which became irreducible two days before admission to the hospital, May 31, 1917. After a large transverse elliptical incision surrounding the hernia was made, a knuckle of completely black gut appeared, the ring was divided and normal intestine delivered. The gangrenous gut was then resected four inches free on each side. The mesentery was very fatty and a side-to-side anastomosis bringing the closed ends of the gut together in same direction was done. Patient made an uninterrupted recovery. A drain was put down through the right lower angle of the wound and there is now a small recurrence of the hernia at this point, which is, however, easily reducible. There was an overlapping done in this case, the upper flap being carried behind the lower flap.

#### SELF-INFLICTED INJURIES

DR SETH M MILLIKEN presented a woman, twenty-two years of age, who was admitted to Lincoln Hospital August 27, 1917, on account of an abscess in the abdominal wall. She was a well-nourished girl, with left arm disarticulated at the shoulder. Numerous scars on the left chest and abdomen. There was a curious sinus, the margins of which showed exuberant, tapiocalike granulations extending toward the umbilicus, near which was situated a large brawny mass. There was a profuse, thin, purulent discharge from the

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sinus Under gas oxygen anæsthesia an incision was carried through sinus for a distance of about six inches, where a hard substance which proved to be a wad of gauze about one-half by one-quarter inch, with a small safety-pin fastened through it was discovered and removed. Sinus was lined with the same watery-looking granulations which were thoroughly curetted out. Wound was packed loosely with gauze and allowed to granulate. About a week later a small pocket formed near outer end of granulating track which was opened by Doctor Brenner on September 6, and the patient was discharged with surface granulations on September 16, and perfect healing was noted in dispensary

The case seemed one of great misfortune with some possible carelessness attached, until in December, 1917, he received a reprint from Doctor Lilienthal which gave the previous history of the case The girl had been under Doctor Lilienthal's care at Mount Sinai Hospital in 1913, when she was seventeen years old She claimed then that about two years before admission she had been bitten by a dog and that there had been several operations on account of infections of the left arm following the injury There was tremendous board-like ædema of the entire left upper extremity, rather sharply limited just above the insertion of the deltoid muscle was an ulcer-like wound of the forearm with sluggish granulations ligneous ædema was most marked in the epitrochlear region, and in spite of the fact that the pulse, respirations and temperature were within the bounds of normal it was decided to explore the epitrochlear lymph-nodes, and this was done on October 4, by open operation There followed several attacks of dermatitis, erysipeloid in character, each accompanied by an elevation of temperature, the redness, however, rapidly disappearing on the application of saturated solution of magnesium sulphate. The appearance of the arm and hand was that of elephantiasis, the fingers being held in the claw-like position resulting from flexion of the phalangeal joints, the metacarpophalangeal articulations being extended This contracture was evidently due to the cicatrix of some previous operation upon the dorsum of the hand The progress of the healing of the wound was extremely slow

For the sake of the histological examination and also in the hope of relieving the condition a strip of the entire thickness of the board-like skin was removed on February 20, 1914, the incision extending from the middle of the upper arm to a point below the elbow posteriorly. This wound was closed by sutures and healed with rapidity. Nothing to explain the condition was found in the speciman

When the patient had been in the hospital for some months it was decided to make a photograph of the patient. During preparation for the photograph the writer saw that she made an attempt to get rid of something near the upper part of the arm and on examination it was found that there was a narrow strip of adhesive plaster tightly encircling the extremity near the shoulder. It was then recalled that the patient had always kept her shoulders covered during examinations until she could prepare herself,

#### SELF-INFLICTED INJURIES

and this sometimes took several minutes. The sudden termination of the pathological appearances in a groove near the shoulder had been noted, but stupidly enough the cause had been unsuspected until the day of the photograph

After the discovery of the adhesive plaster strip the arm was put up in plaster of Paris and only a few days later another photograph was taken which showed a decided diminution of the size of the limb The patient had been kept in bed following this final operation with constant improvement When she was permitted to go about, however, the condition became almost as bad as before, probably because she surreptitiously caused constriction She was then put to bed and kept there under close surveilof some sort lance, and by March 19, about a month after the discovery of the true cause of her trouble, the hands were of equal size and the skin practically There was, however, some main en griffe due to the operation on the dorsum of the hand above referred to

The patient was then discharged
and the prognosis was thought to be good

Three years later in response to a letter she appeared for examination Since her discharge a shoulderjoint amputation had been performed! This operation had preceded her visit by about one year, or in March, 1916, and had been performed by Dr Irving Haynes of the Harlem Hospital, who states that the patient had come to him with an absolutely helpless, contractured arm with osteomyelitis of the humerus, doubtless the result of infection from some of her numerous wounds The patient made an uneventful recovery and her general health has remained good ever since On examining her, however, there were found several large cicatices on the left half of her trunk, two in the left mammary region, one in the posterior axillary line and in addition a large ulcerated granulating surface of the left upper abdomen This wound had a peculiar gelatinous appearance and made the impression that some irritating substance had been frequently applied Doctor Haynes also mentioned that a radiograph of the arm had disclosed the presence of three shadows in the forearm which indicated apparently pieces of needle, the eye being near the point, evidently sewing-machine needles, and our conclusion was that the patient must have inserted these herself radiogiam the groove in the soft tissues near the upper part of the limb can clearly be made out and I doubt not that the patient had again resorted to the rubber adhesive strip before presenting herself at the Harlem Hospital The osteomyelitis of the humerus had been diagnosticated by the X-ray From this it was evident that the sinus which Doctor Milliken opened had been present before Maich, 1917, instead of the two weeks as shown by the history When sent for early in April, 1918, this patient showed perfectly healed scars on her left side, but on the right there was a punched-out ulcer in the upper part of the abdomen with the same sort of ervsipeloid inflammation below it as existed around the abscess opened in August She stated that the punched-out ulcer was the result of a small pimple which appeared about two weeks ago

He now believes that the gauze drain removed by him had been pushed

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out of sight by the patient and that probably the present condition is due to some self-inflicted injury

DR WILLIAM A DOWNES recalled having seen years ago a similar case, that of a girl who went the rounds until she finally got her arm cut off She was eventually proved to be a malingerer. She obtained adhesive plaster and fastened it tightly around her arm in the identical manner as shown in this instance.

#### SILVER FILIGREE IN TREATMENT OF UMBILICAL HERNIA

DR FORBES HAWKES presented a woman who was first seen in March, 1903, at which time she had an umbilical hernia about the size of an orange and irreducible. She had weighed 303 pounds, but had lost a considerable amount of flesh. The operation consisted of an incision down to the hernial sac, the removal of the sac, and the insertion of a silver wire filigree, 2½ by 3½ inches. The filigree was used because it was feared that she would later regain her weight, the muscles thin out and the hernia recur. The wound healed promptly. She still remains in good condition fifteen years later. There has been no recurrence of the hernia. When she lifts her arms high up of bends over in heavy work she can feel the silver filigree (which was inserted subperitoneally, both recti being brought together over the top of the filigree)

DR WILLY MEYER stated that he had practically given up the use of the silver filigree in the repair of umbilical herniæ since the transverse Mayo incision had come into use. He does believe, however, that there are cases with such a defect in the entire thickness of abdominal wall providing nothing for reconstruction where a silver filigree will prove not only of great advantage, but represents the only chance available for a cure, fascia transplantation included. He referred in particular to the total defects in the abdominal wall following radical excision of fibroma or fibrosarcoma of the parietes. Here the first closure of the hole is to be made with omentum, if available. The next layer is the filigree. He lay stress upon the necessity for making the filigree at the time of operation and not depending upon a made frame.

#### HARELIP TECHNIC

DR THEODORE DUNHAM presented a child to illustrate two points—first, the original technic employed, and, second, to call attention to an unfavorable form of postoperative treatment which was adopted. The child had a double harelip with a not very wide cleft under the right nostril and a very wide one under the left nostril. With regard to the unfavorable postoperative treatment the use of dichloramine-T dissolved in chlorcazane was used in the hope that it would overcome the tendency to suppuration which appeared in the wound on the third day following operation. Its use, however, produced a reddening and eventually a separation of the skin surfaces, and in places even holes developed where the opposite freshened surfaces failed to unite. It was only by care that the lip finally healed. Doctor Dunham feels that the puckering of the scar tissue which has resulted in the three months since operation is entirely due to the use of dichloramine-T

#### TUBERCULOUS KIDNEY

He then described the technic of his operation, illustrating the same by diawings. The novel point of the technic was to acquire sufficient relaxation so that the broad cleft could be closed in, without puckering the nostril. This was successfully accomplished by cutting out a wedge of skin on the cheek close to the nose and then sliding the lip across, at the same time closing up the wedge. That brought the angle of the wedge to the midline without disturbing the nose, and the wedge-shaped cuts allowed the lip to slip down with a meeting of the points, and they then met under the trimmed central portions.

#### CHINOSAL AS A DISINFECTANT

DR W C Lusk presented a group of cases in the treatment of whom chinosal had been used. These are to be reported with a more full study of the subject in a paper to be published.

#### TUBERCULOUS KIDNEY

DR John Douglas presented a woman of thirty-two years, who gave a history that one year ago she had pain in the left side of the abdomen and back. Later, pain radiated down along the course of the ureter, she had irregular chills with frequent micturition and bloody urine, she lost ten pounds in weight. Physical examination showed a slightly enlarged left kidney, with moderate tenderness on pressure. Cystoscopic examination showed congestion about the left ureteral orifice. The ureteral catheter entered with difficulty on the left side. The urine from the right side was normal, from the left side contained tubercle bacill. A diagnosis of tuberculous kidney was made. Kidney incision and ligation of kidney vessels was followed by the pulling up of the kidney and the making of a small McBurney incision on the left side through which it was easy to palpate the ureter. An assistant then made traction on the kidney through the posterior incision when it was easy to feel the ureter down to the bladder. The ureter was freed by blunt dissection with the fingers and by blunt scissors to the point of entrance into the bladder, and was clamped close to the bladder, divided between two clamps with the cautery, and the lower end close to the bladder treated with a probe dipped in pure carbolic acid swabbing out the lining of the ureter. Both wounds were healed in two weeks. The operation was done on April 3, and although on discharge the wound was perfectly healed there is now (May 8) a little redness along the lower end of the wound

Doctor Douglas stated that he had operated on several cases of tuberculous kidney where he had either tied off the ureter and left it in the lower angle of the wound, removing as much as possible through a high incision, or opening the ureter, pouring carbolic into it, followed by alcohol, and in many such cases a bad infection of the wound with delayed healing has resulted

This patient is presented to demonstrate the advantage of the Lilienthal method of removal of the ureter in certain cases of tuberculous kidney

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ness in the epigastrium and right upper quadrant with indefinite signs of a Blood count showed 22,000 white cells with 90 per mass in the epigastrium cent polymorphonuclears, coagulation time was thirteen to sixteen minutes The X-ray showed stones in the gall-bladder, bismuth X-ray of the stomach negative Examination of the stools showed 60 per cent fat The Widal was negative Given calcium lactate, transfusion and fel bovis three days before operation Operation was under ether, and very dense adhesions were found about the gall-bladder and duct At operation the gall-bladder and duct were found a mass of adhesions, there were pus and stones in the gall-bladder and common duct, the pancreas was firm, hard and much The cystic duct was two or three times the normal enlarged in the head size, opening into the common duct, well below the normal insertion The operation was cholecystectomy with a T-tube in the common duct after passing a probe into the duodenum. A hemorrhage not noticeable during operation continued from the wound, necessitating the repetition of the transfusion, which controlled the bleeding for a day The hemorrhages occurred in much severer form four days later, and during the last four hemorrhages the most effective treatment was infusion of 2 of a 1 per cent solution of A hernia was expected, but because of calcium in normal salt solution the bile and external hemorrhage a portion of the rectus sloughed away For four or five weeks, although most carefully treated, he grew worse and vomited There was no bile in the stools He was kept alive with glucose infusions 12 to 20 per cent. This was done notwithstanding the fact that he had a pancreatitis On the thirty-fifth day he was markedly distended and complained of distress in the epigastrium He was given a large enema and a double dose of pituitrin with a remarkable result. The next day the sinus was closed and he volunteered the information that he was getting well He has gained 36 pounds since the operation and, although he has some pain in the lower part of the back and shoulder, this is not believed to have any relation to the operation

The second case illustrated a double transverse incision now being used by Doctor Whipple. The man had a perforated duodenal ulcer at a first and second operation and a pericholecystitis. At the first operation he took anæsthesia badly, nine months later with recurrence of symptoms a posterior gastroduodenostomy was done. In the meantime an operation for appendicitis had been performed when the condition in the duodenum had been found but nothing done. The patient now is able to do heavy work, drive a car, and has a firm abdominal wall.

The third case was one in which no diagnosis was made until the receipt of the pathological report. Admitted to the hospital nine months ago, complaining of attacks of indigestion with typical history of digestive disturbance of chronic cholecystits. Had had this trouble for six years with much belching of gas. Ten days previous to admission there was pain and tenderness in right upper quadrant, no jaundice. Had typhoid fever in childhood Examination showed a constant tender point over McBurney's point and over the gall-bladder. An intrarectus incision following the Kammerer

#### DISEASES OF THE BILIARY TRACT AND PANCREAS

principle, drawing the rectus outward and cutting through the posterior sheath, was made. The trouble was found in the gall-bladder, which was thickened, deeply imbedded in liver tissue, was very friable, and contained a large stone and pus, but no bile. The gall-bladder bed in the liver seemed soft, suggestive of an abscess, and cultures showed the bacillus coli communis. Cholecystectomy done, with drainage, and liver tissue removed for examination. Pathological reports showed gumma of the liver and lues of the gall-bladder with chronic cholelithiasis and cholecystitis. Subsequent to the operation a four plus Wassermann was obtained. He was put on mixed treatment and made an uneventful recovery and has done well ever since

The next patient illustrated a recurring gall-stone Admitted to the Presbyterian Hospital September 22nd, discharged January 14th Had an acute cholecystitis with temperature of 1024°, pulse 132 Previous history was that three years before she had a cholecystostomy at another hospital and following operation had recurring attacks of biliary colic with symptoms of indigestion Had two pregnancies Acute symptoms subsided and four days later with a normal temperature operation was done Cholecystectomy, gall-bladder markedly inflamed, walls friable and several stones Culture showed staphylococcus aureus Made a smooth recovery

DR WILLY MEYER stated that the diagnosis of common duct stones was fairly easy when there was intermittent jaundice, the latter preceded by colicky pains In regard to the diagnosis of cholelithiasis he mentioned the cholesterol test and the X-rays, stating that he believed the X-rays would show the stones in about 15 per cent of the cases He believes from 70 to 75 per cent of cases give a positive cholesterol test. He also mentioned the great diagnostic value of the duodenal tube In their hospital, out of ten cases with suspected cholelithiasis in which duodenal aspiration was used, in eight the bile examination turbidity pointed to stones, and the latter were found at operation He referred to Doctor Whipple's intravenous use of glucose for nutritive purposes and suggested that this could be given by the Einhorn tube He referred to a case of his own which ten days following operation developed a duodenal fistula Here the wound rapidly began to be digested and eczema appeared The longest tube in the market was allowed to travel down as far as possible during forty-eight hours. With its help glucose, milk with eggs, etc, were instilled by the drip method, the duodenal fistula healed

With regard to the transverse incision in gall-bladder surgery he referred to the difficulty sometimes encountered with this as well as the perpendicular incision, and states that for the past three years he has used as often as possible Terthes incision. He believes in every instance this gives the best exposure

Referring to the follow-up system, he considered it a very essential point in all up-to-date hospitals, but an expensive addition. At their hospital the follow-up system had just been introduced. As a matter of investment it is the most splendid that a hospital can make, because it produces scientific results.

#### CORRESPONDENCE

#### SINGLE ABSCESS OF LEFT LOBE OF LIVER OF PYOGENIC ORIGIN

Editor Annals of Surgery

It is generally recognized that a high percentage of abscess of the liver is caused by infection with amœba coli, most cases being a complication or sequel of amœbic dysentery. Tropical abscesses, however, are found in which it is impossible to demonstrate amæbæ, and with no coincident dysentery or history of same. Tropical abscesses are nearly always found in the right lobe, some writers placing the proportion as high as 90 per cent. Left lobe abscesses are rare. In approximately 75 per cent. of cases solitary abscess exists.

Abscesses of pyogenic origin are usually multiple. Single abscess is seldom met with. They may be in any portion of the liver. They frequently are caused by suppuration in the small branches of the portal vein, within the liver, or are secondary to a focus of infection elsewhere, as the appendix or gall-bladder, etc. In view of the above mentioned accepted data as to liver abscess the following case has several points of interest which would seem to warrant its reporting.

A marine fireman presented himself complaining of epigastric pain, diarrhœa, fever, loss of weight, weakness, loss of appetite, nausea and vomiting

The present illness began about two weeks ago with frequent bowel movements, which became progressively more frequent (as many as seven per day), some of which he states contained blood (?) He had a feeling of weakness, had very little appetite and lost about ten pounds in weight

Five days ago, he indulged in a prolonged drinking bout, during which he was suddenly taken with a severe pain in the epigastrium. He was nauseated, and vomited. The pain was very sharp in character, and, as the patient states, "doubled him up." He went to bed and remained until the following morning, when he felt better. Later in the following day the pain returned—sharp and cramp-like. He was nauseated, and vomited. The pain persisted, and he was brought to the hospital for relief. He is unable to eat. Food nauseates him. He is passing two or three stools daily. They contain no blood

Past History—Five years ago the man had an attack of dysentery which was complicated by an abscess of the right lobe of the liver—The abscess was drained transpleurally—Drainage continued for about 2½ months after operation

#### CORRESPONDENCE

When admitted he was very restless and apparently in great pain Eyes bright, facies drawn and anxious. The breath is foul and the tongue coated and tremulous. There is an operative scar about 1½ inches in length in the posterior axillary line at level of tenth rib. Tenderness is marked in epigastrium and under costal margin. Gentle palpation in these regions causes patient to wince. This tenderness seems a trifle more in the right epigastrium. The liver dulness is increased both upward and downward.

Fluoroscopic examination shows a diffuse enlargement of liver—both right and left lobes The enlargement is very marked in the right lobe. A skiagraph confirms the above

Laboratory—White cell count, 14,000 and 12,800 Polymorphonuclears, 90 per cent Amæbæ not found in stools Malarial parasites not found Urine negative

Operation —A modified Mayo-Robson incision made over right rectus On entering the peritoneal cavity, dry adhesions between the surface of the liver and parietal peritoneum were found

The liver presented itself considerably below the costal margin. The right lobe was diffusely enlarged. The presence of an abscess in this lobe could not be demonstrated. On examination the left lobe was also enlarged. An elevation of about six centimetres in diameter was palpated on its upper anterior surface.

A second, small incision was then made through the left rectus, directly over the elevation. The area was packed off with gauze strips. A trochar and cannula were introduced, and a thick, creamy, yellow pus was evacuated, which was not foul smelling. There was no reddish or chocolate colored material in the abscess cavity. The abscess cavity was irregular in outline, about the size of a hen's egg, and was traversed by trabeculæ. The first incision was closed completely and a rubber drainage tube inserted through the second opening. Amæbæ were not found in the pus evacuated or that taken from the walls of the abscess cavity. No bacteria were visible in stained sinears. Staphylococci appeared in later cultures.

With the exception of a few minor difficulties, the man's recovery was uneventful and he was discharged from the hospital entirely free from symptoms and with operative wounds entirely healed

We have in this case a single abscess apparently of pyogenic origin, occurring in the left lobe of the liver five years after an abscess, etiology unknown, but probably amæbic, in the right lobe of the liver A second liver abscess, with recovery, in the same individual is not common. Abscess of the left lobe is uncommon, a single pyogenic abscess is rare

Amæbic infection cannot be absolutely ruled out, but their presence was not demonstrated. A diarrhæa was present at time of admission. The stools were not typical of amæbic dysentery and amæbæ were not

#### CORRESPONDENCE

found in them This diarrhoea cleared up without treatment before drainage of abscess was complete. No emetine preparation was given at any time. Relief was immediate, following drainage, and recovery was complete.

ROBERT BOOTH ACKER,

Assistant Surgeon, U S Public Health Service,
U S Marine Hospital, New Orleans, La

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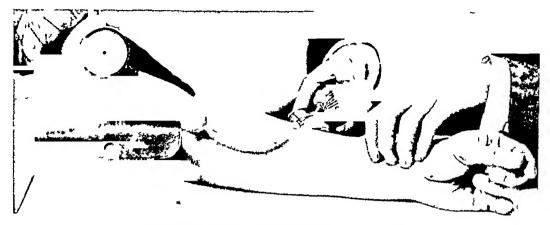
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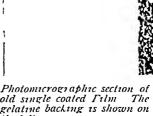
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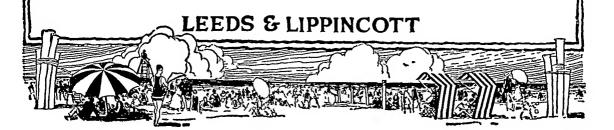
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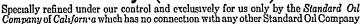


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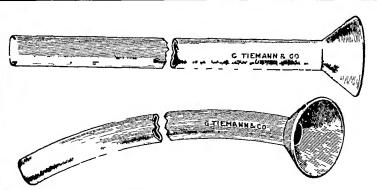
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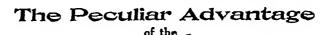
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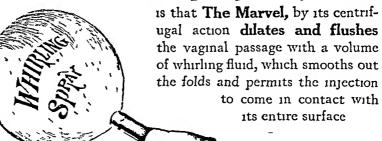
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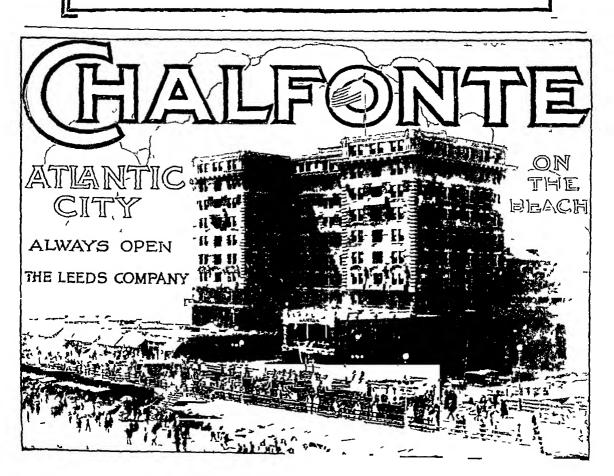
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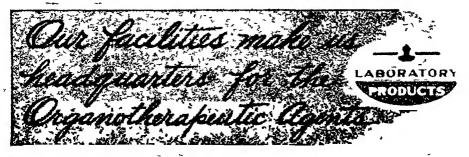
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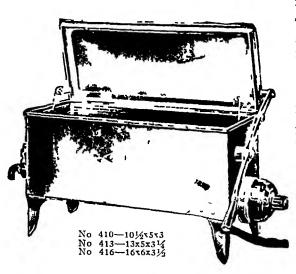


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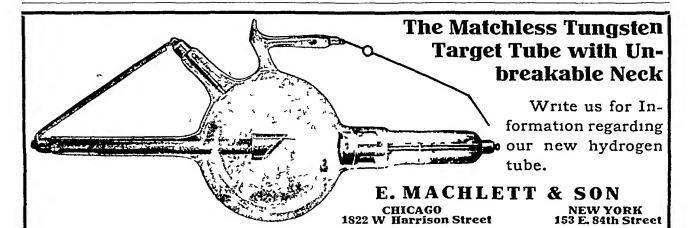
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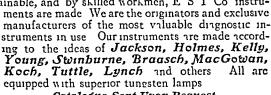
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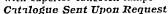
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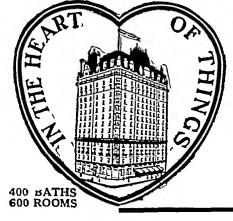
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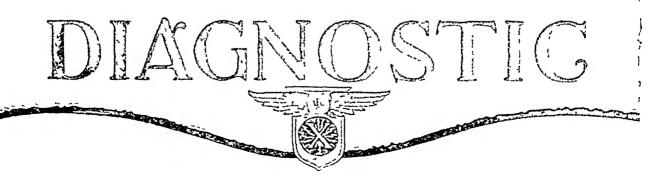
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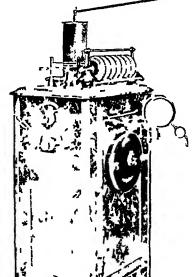
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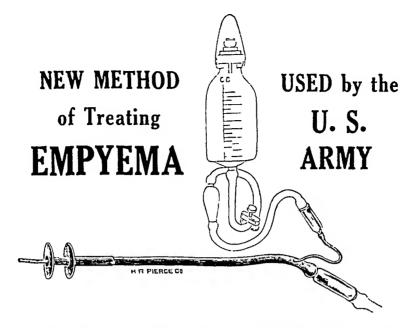
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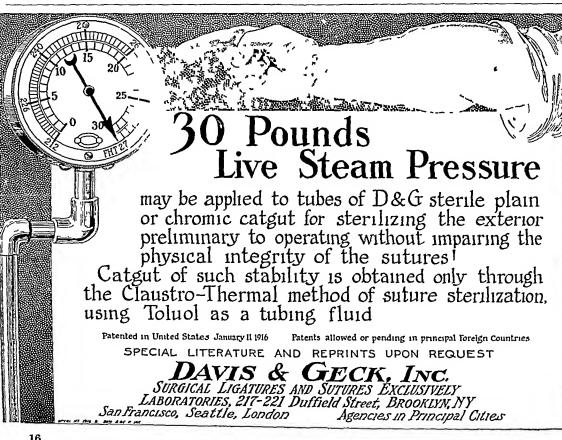
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# ANNALS of SURGERY

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# PRELIMINARY REPORT OF A METHOD FOR ESTIMATING IN VIVO THE GERMICIDAL ACTIVITY OF ANTISEPTICS

By Joseph A Perkins, M.D

During the past month at the Pennsylvania Hospital we have been trying to develop a method by which we could estimate the germicidal activity of antiseptics in infected wounds

The method of estimating and graphically recording the bacterial contents of a wound with the microbe charts works out well clinically, but the results are, at best, a very crude determination, because the area of the smear examined (counting to or 20 fields through a  $^{1}/_{12}$ -inch oil-immersion lens) contains a very small proportion of the microbes removed from the wound on the platinum loop. Be the smear as smooth and even as is humanly possible to make it, the margin of error is still very large. With a view to reducing this margin of error we have been culturing the wounds, counting the number of colonies and plotting curves as in the microbe charts mentioned above. Admitting that there is still much to be desired, in that the size of the drop obtained on the loop is still a variable quantity, we feel that we have a very much truer estimation of the bacterial content of the wound than when using the smear method

In order to reduce as far as possible the element of the personal equation, the work has been done by one man. The inoculations were made from the same part of the surface of the wound, one definite spot being selected and used throughout, the attempt was made to get a uniform-sized drop, the same platinum wire loop was used each time. The drop obtained was inoculated at the bedside in 2 cc of plain bouillon, the bouillon suspension, undiluted, was immediately poured over an agar-agar plate, which was then covered and turned upside down and marked with the patient's number, the number of the culture, and the time the culture was taken. The plate was then taken to the laboratory and placed in an incubator and kept at thirty-seven degrees C. At the end of twenty-four hours the colonies were counted, macroscopically, and recorded

The first case, an incised carbuncle with several discharging sinuses, gave, as you will see on Fig I, rather irregular curves. We believe that as the patient turned about in bed during the day some sinus discharged pus and bacteria which ran over the area from which the inoculations were taken, a point on the surface of the bottom of the wound and in the centre of the star, reinoculating that area and, therefore, giving a very

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#### **TOSEPH A PERKINS**

distorted idea of the progress of disinfection. It does show, however, after dressing with dichloramine-T, the initial drop or practical sterilization of the wound surface followed by the gradual reappearance of organisms, the germicidal activity lasting at least sixteen hours in the first curve and fourteen hours in the second

Two other cases were then chosen, each with a localized infection and without any demonstrable sinuses

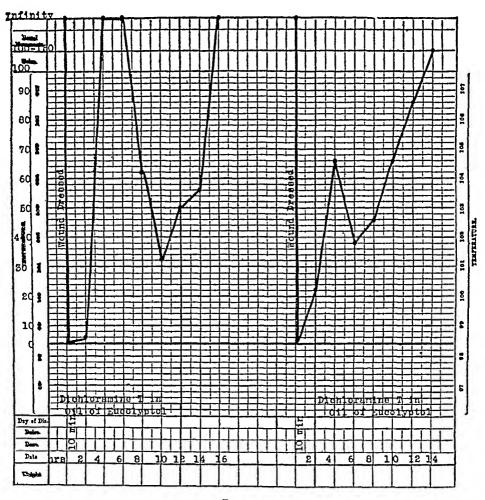


Fig 1

The first, an Italian laborer twenty-seven years old, admitted December 22, 1917, sent in from Out-patient Department with diagnosis of chronic osteoperiositis of the right tibia

Three years ago the patient had had an operation upon this region of the leg, the wound healed quickly and the patient had had no further trouble until the present illness started two weeks before admission. The X-ray taken from dispensary showed a localized osteomyelitis and probable beginning sequestrum.

#### GERMICIDAL ACTIVITY OF ANTISEPTICS

December 27, 1917 The soft tissues of the leg were incised, the medullary cavity exposed for a length of 1½ inches (A culture from the infected medulla showed staphylococci) A moderate amount of pus and infected medulla was removed but no sequestrum found The wound was then packed with gauze in dichloramine-T (5 per cent in oil of eucalyptol) No sutures were inserted The packing was removed at the end of twenty-four hours, and until the eleventh day the wound was dressed daily with dichloramine-T

The microbe (smear) chart showed practically a straight line above infinity from the time of operation until the eleventh day. That day, before diessing, a culture was taken as described above. The wound was then dressed with dichloramine-T in oil of eucalyptol. Ten minutes later another culture was taken. Thereafter, for twenty-two hours, a culture was taken every two hours. The wound was dressed again. Ten minutes after dressing, another culture was taken. The results are shown on the first curve of Fig. 2

From the twelfth to the eighteenth day the wound was dressed only with clean dry dressings. This time was allowed for the culture to again reach infinity. No antiseptics were used. Cultures were taken at irregular intervals.

On the eighteenth day, the plates having been at infinity for three days, the two-hour cultures were started again. This time hypochlorite solution was used. Cultures being taken ten minutes after dressing, one hour after dressing and then every two hours. The results are shown on the second curve of Fig. 2

On the nineteenth day hypochlorite solution was used again. The wound was treated every two hours for twelve hours (hypochlorite solution being instilled after the Carrell method). Cultures were taken before diessing, ten minutes later, one-half hour after dressing, one and a half hours and two hours after dressing each time. (The hypochlorite solution (Dakin's solution) was titrated and tested with phenol-phthalein before and after using)

On the twentieth day, the wound was cultured before dressing, then dichloramine-T in the chlorcosane solvent was applied. Ten minutes later and then every two hours cultures were taken

On the twenty-first day dichloramine-T in chlorcosane again was used, the wound cultured ten minutes later, two hours later, twelve hours, twenty and twenty-two hours after dressing

The results were recorded graphically on the ordinary temperature charts used in the hospital

The other case, the results of which are shown in Fig 3, was an American, forty-nine years old, a plumber by occupation, admitted January 3, 1918, with diagnosis of abscess of the right leg. The patient had had a chancre twenty years ago, but Wassermann reaction in blood taken while in the hospital was negative. X-ray reported. No evidence of bone change

January 4 The wound had the appearance of a small carbuncle, was excised under ether, and the wound was packed with gauze saturated with dichloramine-T 5 per cent in oil of eucalyptol

#### JOSEPH A PERKINS

Day after operation Packing was removed and for the next two days the wound was dressed every twenty-four hours with dichloramine-T 5 per cent in oil of eucalyptol

Third day after operation Cultures were started, as on the other case, and carried through in a parallel series and results charted

In the first series, using the dichloramine-T in oil of eucalyptol once in twenty-four hours, following the initial drop there is a slow gradual rise in the curve, showing, we believe, a continual activity of the germicidal properties of the antiseptic lasting 16–14 and 18 and 20 hours, respectively, in the three cases

Then with hypochlorite solution, there is again the initial drop followed this time by an immediate rise to infinity, in one case within an hour, in the other, two hours, showing the admittedly short time the antiseptic is active

Using the hypochlorite solution every two hours, there is each time the initial drop, but each time before the following two hours are up, there is the rebound back to infinity, and after six instillations of the hypochlorite solution, twelve hours' treatment, the bacterial count is still above infinity, as against the comparatively low count of 100 and 62 in the same cases twelve hours after a single treatment with dichloramine-T

In the last two charts, using again dichloramine-T, this time in the chlorcosane solvent, we have the initial drop followed by the gradual rise in the count, showing a germicidal activity lasting throughout the full twenty-two hours

We feel that through this method some idea can be obtained of the comparative strength of antiseptics and the length of time during which they are active when applied to human tissues in the presence of infection

#### TREATMENT OF GUNSHOT FRACTURES OF THE MANDIBLE\*

### By John B. Roberts, M D.

PROFESSOR OF SURGERY, UNIVERSITY OF PENNSYLVANIA, GRADUATE SCHOOL OF MEDICINE

Gunshot wounds of the lower jaw furnish very variable and many complicated fractures of that piece of the human skeleton. Blows received from slowly moving heavy projectiles may cause breaks practically indistinguishable from those seen in civil practice. Small rapidly moving bullets may simply bore a hole through one or both sides of the mandible, traversing the enveloping soft tissues with little damage. Large pieces of the body or either ramus of the mandible may be carried away or the fragment's driven into the mouth, pharynx, or the soft structures of the face

In addition to the comparatively inconsequential injuries, multiple and comminuted fractures occur from pieces of shell casing and from shrapnel, from secondary projectiles thrown into the face, and from blows with rifle butt, sword or bayonet. This discussion might be called a consideration of war, instead of gunshot, fractures of the mandible

The shape, situation and function of the lower jaw and its relation to other facial structures lend to the vulnerating missile an extraordinary opportunity for serious complicating lesions. Much of the difficulty found by the surgeon in his attempt to restore the patient to his former military efficiency comes from the complications arising from sepsis is common to all war wounds and needs no special consideration. removal of projectile and contaminating foreign substances, the prevention of infection by early aseptic excision of damaged tissues, the use of chemical antiseptics and the evacuation of cavities containing albuminous fluid liable to putrefaction should differ to but a moderate degree from the same activities in other regions It may be said, however, that in the face an abundant vascularity, a free anastomosis of blood-vessels and the consequent unusual resistance to microbic attack permit greater retention, at the hands of the surgeon, of splinters of bone and of partially devitalized soft tissues than is wise in the limbs or trunk The difficulty of maintaining a dry wound after reduction and fixation of an open or an infected fracture adds to the possibility of subsequent suppurative inflammation and septic necrosis Establishment of free drainage by incision below the mandible, with introduction of tubes, so that gravity may aid in the escape of infected discharges, will do much to obviate the evil of saliva, food and nasal mucus reaching the wounded surfaces Giving water and liquid food through a funnel and soft rubber tube, for a week or ten days, may be very valuable as a preventive measure in fractures accompanied by wounds likely to assume septic complications

<sup>\*</sup>Read before the Philadelphia Academy of Surgery, April 4, 1918

#### JOHN B ROBERTS

When one recalls the shape and function of the mandible, the real reason for its frequent malformation after union of a fracture is obvious. The bone reminds one of a crude horseshoe, with a high caulk at each end, applied to the skull upside down. Each caulk terminates in two projections. The posterior projection ends in a cylindrical knob for articulation with the temporal bone of the cranium, the anterior is flattened for the grasp of the tendinous insertion of the temporal muscle. This rude model of a horseshoe is furnished with sixteen sockets, on the same edge as that from which the caulks arise, for the roots of the lower teeth. When man opens his mouth for eating, drinking, or speaking, the mandible moves downward from the cranium and face as a hinged bottom drops from a box. The axis of motion is a transverse line drawn through the two ramical little above and a little behind the third lower molars. In addition to the open and shut movement of the jaws, there occur, during mastication, crushing and grinding motions of the molar teeth, caused by the action of the masseter and pterygoid muscles.

It is fortunate for patients who sustain fracture of the lower jaw (mandible) that the two upper jaw bones (maxillæ) above furnish an immovable anvil against which the teeth of the mandible strike in chewing food. This anvil-like mass of bone and teeth may be utilized by the surgeon as a splint to support and steady the broken lower jaw after its fragments have been so replaced as to reconstruct the dental arch. This may be done with muslin bands furnished with hooks glued to each jaw and then laced

It is an axiom that the broken mandible should have the contour of its body or arch readjusted in a manner to reproduce the occlusion of upper and lower teeth existing prior to the occurrence of fracture. The surgeon thus has his patient's upper jaw for a standard, by which to assemble the various fragments of the mandible found in a gunshot or a comminuted fracture. This happy condition may be unattainable, because many patients have previously lost teeth in one or both jaws, or some teeth have been carried away by the gunshot force which produced the fracture awaiting reduction.

The usual fractures occurring in the body of the mandible are not difficult to reduce and keep reduced, if both jaws have intact teeth. The difficulty of reduction is usually not great in other circumstances, unless there has been great loss of teeth or marked ablation of bone by the trauma of the projectile. One readily obtains a proper occlusion of the teeth, and then holds the mandible against the maxillæ by means of an external bandage, chin-strap, or splint. In comminuted injuries the reduction is not apt to be easy, and its maintenance may be difficult. The absence of teeth, even if only a few have been lost, prevents very often the successful employ of the upper jaw as a supporting splint. The operator must then devise a method of fixing firmly the fragments in apposition by means of interdental or intermaxillary splints or by the adaptation of some mechanical connection or bridge between the major fragments.

#### GUNSHOT FRACTURES OF THE MANDIBLE

The general surgeon may undertake the treatment of severe fracture of the body of the mandible with some hesitation, because he realizes his unfamiliarity with dental manipulations within the mouth. Much of this is due to a want of consideration of the relations of the teeth to the fracture and a neglect of a study of the mechanical and anatomical needs of the injury. A dental surgeon may have, it is true, a manual dexterity and an experience which give him an unusual facility in treating mandibular fractures, but a surgeon without a sufficient degree of alertness and deftness to learn the few needed manipulations must be a sorry surgeon also in other technical procedures. The principles by which fixation of mandibular fragments is to be obtained can in all most exceptional cases readily be learned by a painstaking and conscientious operator. It is well for us to take steps to acquire such knowledge

Reduction of the fracture by pressure of the fingers on the teeth is generally easy, though comminuted fragments or displaced teeth may cause interlocking and require removal before correct apposition is obtained. Teeth which are simply loosened should not be taken out unless they impede reduction or are situated within the line of fracture, then it is wise to extract them. The normal relation of the upper and lower teeth in most mouths brings the upper incisors in front of the lower when the mouth is closed.

In usual fractures of civil life, little tendency to displacement is shown after the lapse of ten days of treatment. Retentive dressings may usually be removed about two weeks from the time of readjustment of the dental arch. The patient may then be given an opportunity to cautiously chew soft food and to demonstrate whether the fragments have been so adjusted as to give the best use of the teeth for mastication. Consolidation at that time will not be so complete as to preclude slight changes at the hands of the surgeon for a better adjustment of fragments.

After the surgeon has brought the fragments into apposition in uncomplicated fractures, the upper and lower teeth should be kept in contact by closing the mouth and then holding the mandible firmly against the upper jaw by a figure-of-eight bandage of occiput and chin, or by some similar appliance, to prevent the patient opening his mouth. This is not a difficult matter if all or nearly all the teeth are present in both jaws

The mouth should be cleansed with disinfectant washes frequently, and feeding carried out by introducing liquids through the crevices between the teeth or through a tube passed between the cheek and teeth into the space behind the last lower molar. The hair and beard of men should be closely cut before external bandages are applied, in order to prevent slipping of the bandage and to add to the comfort of the patient. When a simple bandage will not give sufficient firmness or when its lateral or backward pressure causes over-riding of fragments, a molded splint should be applied to the outside of the skin, to constitute a hollow cap fitting the front and lower surfaces of the mandibular region. The splint should extend on each

#### JOHN B ROBERTS

side nearly as far back as the angle of the jaw. It may need a crescentic portion of its posterior edge cut away in order to avoid pressure on the throat above the larynx. The splint is to be padded, unless molded from gypsum and gauze, vulcanized rubber, or modelling compound. Before applying the bandage, the chin splint may be steaded by carrying a strip of rubber adhesive plaster over the splint and bringing the ends high up on the cheeks. Although most fractures in the dental arch communicate with the mouth by tears of the closely adherent gums, the fracture does not usually become infected. This rule does not hold good, however, if the fracture is a communiced one or the mouth allowed to continue fetid during the treatment.

If the tendency to displacement is persistent, wiring the fragments together, or fixing one or more teeth of the mandible against those of the upper jaw by wires carried across from the teeth of the mandible to the teeth of the maxillæ may be a valuable expedient Provision must be made for immediate release in the event of vomiting from anæsthesia or seasickness. Sometimes fixation by an intraoial or dental splint becomes necessary. Wiring the fragments in position may be done by passing a strong silver thread around several teeth on each side of the fracture and twisting the ends tightly with pliers. Rebellious fractures may require the ends of the bone to be drilled and wire sutures passed through the drill openings. This is most apt to be needed when the jaw is toothless or greatly atrophied near the point of fracture

Dental splints are appliances worn inside the mouth and so fitted to the teeth and alveolus of the mandible that motion at the seat of fracture is prevented. A plastic impression of the teeth and alveolus is taken while the fragments are held in position, and from this a splint to fit the irregular outlines is made of rigid material. In making an intermaxillary splint, a similar impression is taken also of the maxillæ above. By means of impressions thus made in plaster-of-Paris, a splint of metal or vulcanized rubber is constructed with indentations into which the properly adjusted teeth properly fit By applying such a dental or intermaxillary splint to the teeth, the bone is held continually in contact with it and mobility at the seat of fracture rendered impossible. This immobility is due to the crowns of the teeth being buried in the indentations on the surface of the splint simple dental splint fitting the teeth of the mandible alone and fastened to the alveolus may be sufficient. Instead of a dental splint, it may at times be better to construct a splint with indentations to hold the teeth of the upper jaw on one surface and the teeth of the lower jaw on the other This is the intermaxillary splint. If a splint is made for the mandible alone it is fastened to the jaw usually by rods coming from it at the corners of the mouth and then attached to a splint beneath the chin This device is probably not as convenient and satisfactory for preventing lateral movements as the intermaxillary splint steaded by close contact with the upper as well as the lower teeth

#### GUNSHOT FRACTURES OF THE MANDIBLE

A temporary splint may be made by softening a gutta-percha strip in hot water, molding it to the crowns of the lower teeth so as to overlap the adjacent gum, and hardening it with cold water. Such a splint may be held in position by wires carried by means of needles through the muscles in the floor of the mouth, and out through the skin of the chin, so that they may be twisted under the mandible over small rolls of plaster or pieces of cork In subjects who have lost all or nearly all their teeth, interdental splints molded to the atrophied gums present about the only efficient means of maintaining immobility In all forms of splints greater immobility will, as a rule, be obtained by bandaging the jaws together If desirable, guttapercha wedges may be placed between the jaws on each side of the mouth, in order to have a space in the middle for introduction of food. A crude form of intermaxillary splint may be made of cork cut to fit the teeth of the An impression tray, such as is used by dentists in taking impressions for dentures, may be utilized as an emergency splint by putting softened modelling compound in its grooved surface and attaching wires to be thrust through soft parts and twisted under the mandible outside of the face

Union of ordinary fracture of the mandible takes place in about five weeks. In many cases apparently likely to give bad position there is ultimately quite a good result, provided that sepsis does not occur and a fairly good apposition of fragments is maintained during the early stages. This statement, however, is subject to many qualifications, the most important of which is that a general surgeon without technical knowledge of the value of dental skill may obtain much poorer results alone than if he has the advice of an able dentist. The tray idea may be utilized to form an intermaxillary splint, if the surgeon will fasten two trays together by means of a posterior hinge. Softened modelling compound placed in the gutter of each tray will allow impressions to be taken. When the compound has hardened the trays and their contents will be efficient as an emergency splint

When there is a considerable loss of the bone at or near the symphysis, the two fragments will probably be drawn together by the muscles displacing the broken bone, this later will be increased by cicatricial contraction. Thus is given a narrow arch, and sometimes the contraction makes a V-shaped lower jaw. Such a deformity makes it impossible for the teeth in the mandible to have proper occlusion with those of the maxilæ. The patient, therefore, is unable to properly masticate food. When the fracture is in the lateral portion of the body, the larger fragment is usually drawn toward the smaller which is situated on the fractured side. This causes deviation of the chin to the broken side.

The normal occlusion of the teeth should be re-established in gunshot fractures as soon as possible, even before there is any general suturing of stripped-off soft tissues, if these are greatly lacerated. Unless this is accomplished, the fracture displacement will probably become permanent and reconstruction of the contour of the face very difficult to effect. When

#### JOHN B ROBERTS

a portion of the bone is deficient as the result of fracture, the immediate treatment should be conducted in very much the same way as that which is necessary subsequent to excision of the mandible for tumor or necrosis. The operative or accidental loss of a portion of the body of the bone requires that displacement should be prevented early by holding at once the pieces in normal position. This may be done by placing between the ends some plastic material which becomes hardened after its adaptation. The ends of the bone may be held in position also by heavy wires bridging the gap and attached to the teeth on opposite sides. The rigid wire used in this manner, when there are no teeth for its attachment, may be inserted in the inferior mandibular canal or passed through drill holes made through the sawed off ends of the bone.

Several forms of splint have been devised for this purpose. Bands or caps may be fitted or cemented to the teeth and a metal arch or a vulcanite substitute for the bone be introduced between the fragments. After a few weeks wearing of the apparatus, the displacing tendency may, perhaps, be overcome. Vulcanite prosthetic parts of the bone may be used to support plastic flaps, and vulcanite plugs may be used to push the collapsed cheeks into proper position, so as to remedy traumatic deformity. Temporary fixation is, therefore, to be always sought in war surgery as early as possible. A dental surgeon may be needed to properly make and apply the special forms of intraoral splint or apparatus needed to maintain adjustment of mandibular fragments in civil as well as military surgery. Torn-off soft tissues may sometimes be held against the underlying bones of the face with tacks or small staples driven into the bone. The bones may be kept coapted at the seat of fracture with screws or fracture plates of steel or aluminum. This method is usually inferior to that by intraoral splints

Most gunshot fractures of the mandible are open and, therefore, liable to become contaminated, and later infected. The treatment of the wounds has been touched upon already. Large areas of skin and muscle may be detached from the bones of the face in gunshot wounds. The raw surfaces should be cleansed and well painted with tincture of iodine, or dichloramine-T, or other antiseptic, and vulnerating missiles and foreign bodies thoroughly removed as soon as possible after injury. These fractures should be reduced immediately and the fragments fixed. Even a temporary fixation of fractures is of distinct value as a preliminary to reconstruction of the facial outlines.

If the mandible alone is broken, the upper jaw may be used as a support or splint. To do this, place a mass of softened modelling compound between the upper and lower teeth and drive the upper jaw and mandible into it in the position of occlusion. The composition is then allowed to harden in position. This gives a very fair splinting of the broken lower bone. The chin may be supported with a cap of pasteboard, metal, or modelling compound held in position by a figure-of-eight bandage of occiput and chin Fastening the upper and lower jaws together by wire ligatures around oppos-

#### **GUNSHOT FRACTURES OF THE MANDIBLE**

ing teeth of the bones may also be serviceable until a better form of apparatus for steadying the broken mandible can be obtained. Some of these methods may in fact be employed as a permanent means. They may also be used at times in steadying fractures of the upper jaw, though in these there is usually less displacement than in those of the more movable mandible

The soft parts may be brought together over the broken bone after the fracture has been reduced. They should not be sutured so closely as to interfere with drainage if there is a probability of infection becoming marked. Care should also be taken not to stitch the muscles and skin in so tight a manner as to tend to reproduce deformity at the seat of break. When large flaps of tissue have been torn from the bones, stitches occasionally need relief of strain. This may be accomplished by molding plates of vulcanite to the forehead and cheeks, fixing these by straps around the head and connecting with them by jointed steel springs of heavy wire. To the ends of these springs are attached truss pads to press and hold like fingers the detached soft parts into normal position. Tacks or staples may be employed to hold such accidental flaps against the bone, if sutures are not available.

Drainage will be particularly needed in damaged tissues of the lower facial region and chin. This should be provided for in some cases of fracture of the lower jaw by incision below the inferior margin of its body Practically all fractures of importance in the alveolus and body are contaminated through the wounded gum with saliva and food products. Many such fractures will probably heal more promptly if, at the time of the original dressing or shortly afterwards an incision is made below the inferior margin and drainage established. The gum is torn at the time of injury because it is so closely adherent to the bone. This adherence, however, is a protection against spreading of infection.

There occurs at times great swelling from laceration of the tongue or infection of that organ and the other tissues within the mouth. This complication may require that the breathing of the patient be provided for by laryngotomy. Possibly a tracheotomy some distance below the larynx even may be demanded. If the attachment of the tongue to the symphysis of the mandible is severed by reason of operation or the complicated character of the fracture, the patient may become asphyxiated by the tongue falling backward and closing the opening of the glottis by pushing the epiglottis downward and backward. To avoid this catastrophe, the swollen tongue may need multiple incision to lessen its bulk. It sometimes is wise especially after anæsthesia to put a long string through the end of the tongue, knot it at the ends and leave a hemostat attached to it. This instrument by its weight holds the tongue forward, and can readily be seized by the patient himself or nurse to re-establish breathing, should the tongue fall dangerously backward. This string with the attached hemostat may be removed at the end of twenty-four hours.

Major V. P. Blair gives a valuable series of suggestions on the treatment

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of mandibular fractures due to gunshot and shrapnel injuries These may be epitomized as follows

(1) Fractures of the body of the mandible in front of the last existing tooth with no loss of bony substance This type may occur from concussion without the projectile striking the jaw Fixation may be obtained by the usual methods of civil practice

Hullihan continuous dental splint and Gilmer's vulcanite lingual band splint wired to teeth, shown in this article, are satisfactory in such cases

- (2) Fractures of the body of the mandible in front of the last existing tooth with considerable displacement or considerable loss of substance and with few teeth remaining. The majority of gunshot fractures, according to Blair, belong in this class. Fixation is to be secured in the two usual varieties as follows.
- (a) With loss of substance at the symphysis the tendency is for the fragments to be drawn together in front with the occlusal surfaces of the teeth facing each other
- (b) If the loss of substance is in the lateral portion of the bone, the fragment on the sound side is drawn over toward the affected side

In both instances, the fragments, which are separated by a gap due to the avulsed bone, are best held apart and fixed in normal relation to the upper teeth by the metal jacket and wire splint described by Hayes This may be made in one solid piece, or it may be applied to the bone in sections, which are subsequently fastened together

- (c) When there is a tendency for the lower jaw to swing over to one side, on account of the loss of substance, the outer surface of the splint on the opposite side may be furnished with a metal flange to engage the teeth of the upper jaw. This acts as an inclined plane to throw the teeth into proper occlusion when the jaws are closed
  - (3) Fractures of the mandible behind the last existing tooth

These fractures include those of the body of the bone, the ramus, and condyle

- (a) If no tendency to displacement is present and no loss of substance has occurred the simplest method of treatment is fixation of the lower jaw to the upper with ligature wires directly applied to the teeth, or by the employment of Gilmer's posterior or lingual arch already shown in a previous figure. Always provide for prompt release of the jaws to permit vomiting if the wounded man is liable to seasickness or vomiting from any cause
- (b) Fractures of the angle and ascending ramus with loss of bone without displacement may be treated by wiring without splint (see Fig. 1)
- (c) If the ramus is displaced either forward or laterally, the anterior fragment may be fixed by wiring the teeth to those of the upper jaw and the ramus steadied by means of an intraoral plastic splint of modelling composition. This is molded within the mouth. The ramus is drawn back with a hook introduced through the cheek or a lion-jaw forceps holding it through the skin. While it is thus supported the modelling compound

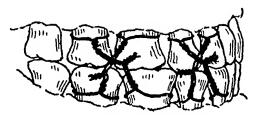


Fig. i.—Gilmer's method of fixition by holding mandible against maxillæ with wires around necks of the teeth (Blair from Gilmer's Oral Surgery )

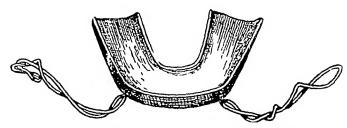
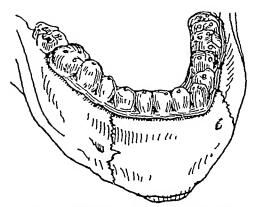


Fig. 2 —Impression tray to be used as Kingsley splint temporarily by filling it with softened modeling composition (From Blur's Injuries of Jaws )



Fic 3 —Hullihan continuous dental splint (Blair after Angle)

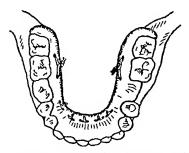


Fig 4 —Gilmer posterior band splint in place (Blair)

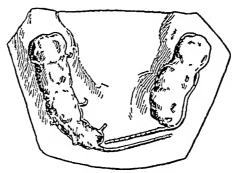


Fig. 5 — Model of a sectioned metal jacket and wire splint, the two hilves to be lashed together with fine wire (Blur after Hayes)

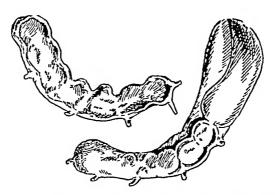


Fig 6a -Swaged metal jacket splint with hooks for ligature wire (Blair after Davenport)

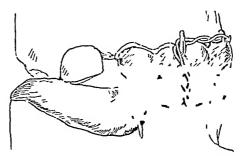


Fig. 6b — Model showing swaged metal jacket splint as applied to teeth and wired to fix jaws (Blair after Datenport )

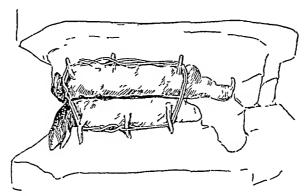


Fig. 6c — Model showing swaged metal jacket splint as applied to fix jaws together (Blair after Davenport )

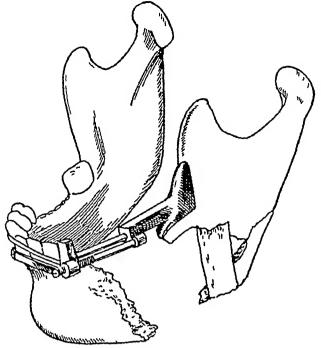
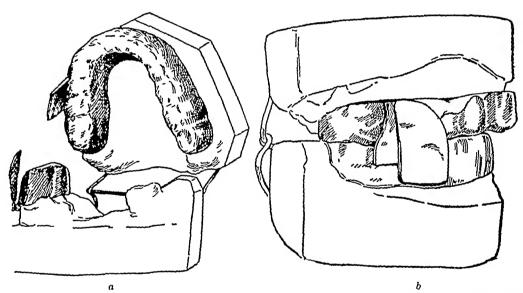


Fig. 7 —Lower bar and saddle splint (Blair after Herpin)



 $F_{1G}$  8 — Metal jacket splints with inclined planes to throw teeth into proper occlusion when mouth is closed by bringing jaws together (Blair after Hayes)

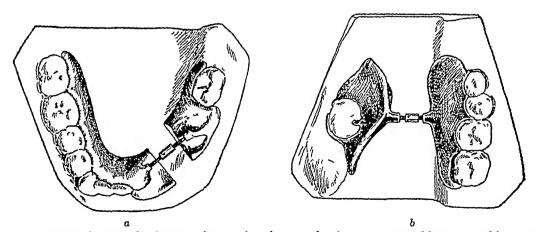


Fig. 9—Models of sectional vulcanite splints with jack screws for slow separation of fragments of fractured mandible drawn together by muscular traction

#### GUNSHOT FRACTURES OF THE MANDIBLE

is introduced, applied to the maxilla above and the ramus of the mandible and allowed to harden between the ramus itself and the last molars of the upper jaw, but continuing downward behind the mandibular molars. Remember the danger of a locked mouth in the event of vomiting during transportation or travel by sea

- (d) If no teeth are available for wiring the jaws against each other, intermaxillary fixation with ligature wire may be applied. This is done by drilling holes through the mandible at the level of the roots of the teeth about three-quarters of an inch distant from the fracture line on each side. Through these openings strong wire is carried and twisted so as to hold the fragments in coaptation. Other holes are drilled in the upper and lower jaws in the incisor region, or in other satisfactory sites, and wires for approximation and fixation are carried through both jaw bones so as to give firm contact of mandible to maxillæ. The fracture is then reduced and all the wires twisted to maintain the corrected position at the seat of fracture Early release may be afforded by teaching the patient how to cut or untwist the ends of the wires in case of nausea or vomiting. Long ends to the wires or the habitual presence of strong scissors may thus save life from threatened suffocation with vomitus.
- (e) Upper and lower swaged metal jackets may be found serviceable in the fractures under discussion. Sometimes the tendency to displacement in a lateral direction may be overcome by attaching to the splints hooks to which intermaxillary rubber bands may be fastened. If it is thought necessary to hold the jaw in fixation with the mouth open, in order to prevent forward displacement of the ramus, the Herpin splint seems available and likely to be useful.

Gunshot fractures of the mandible are so essentially open fractures in most cases that osteomyelitis and other septic complications are common Necrosis may thus impede union and cause permanent non-union with atrophy of the ends of the fragments. A definitely false joint may result at the point of fracture. Violent primary hemorrhage may occur from the missile injuring the lingual, facial, or one of the carotid arteries. Secondary bleeding may threaten the life of the patient. Septic ædema of the tongue, throat or glottis may give origin to dangerous dyspnæa. Unintelligent treatment or the character of the osseous injury may cause union to occur with great deformity of the mandible, malocclusion of the teeth or facial disfigurement from scar contraction. These sequels require active operative treatment on general surgical principles. Bone transfer by flap from clavicle or grafting from rib or tibia may enable the surgeon to reconstruct the mandibular arch, or he may use a graft of costal cartilage for this purpose

It is probable that about one-half inch of lost substance in time may be reproduced across the gap between the fragments of a broken mandible, if normal occlusion of the teeth is maintained by fixing the jaws together Morestin prefers for grafting sections of the sixth, seventh, and eighth costal cartilages. These he shaves into proper shape with a knife, and accurately

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fits them into the gap with their ends driven into the bone. He uses such grafts to reconstruct the angle and vertical ramus as well as the horizontal ramus. Although the cartilage may not be converted into bone and may not actually assume firm union with the ends of the fragments, the false joint is not, he says, of much disadvantage. Fixing of the jaws together is necessary in the after treatment.

Pont advocates the use of tibial bone grafts and insists upon absolute fixation of the mandible against the maxillæ after the grafting operation. This immobilization is maintained for several months. Instead of grafting, a bone transfer may be made by chiseling off a part of the sternal end of the clavicle, leaving the sterno-mastoid attachment as a muscular pedicle, or by turning up a flap from the chest and neck, including a plate of bone from the front of the clavicle.

Further experiences of these and other writers will probably modify methods in minor details

A CONSIDERATION OF 8589 CASES OF HERNIA TREATED BY RADICAL OPERATION FROM 1891 TO 1918, WITH SPECIAL REFERENCE TO METHODS OF OPERATING AND END RESULTS

#### By WILLIAM B COLEY, M.D.

AND

#### J P HOGUET, M D.

OF NEW YORK

In order to study the merits of the surgical treatment of hernia it is essential to consider a large number of cases that have been operated upon We have therefore collected all of the cases operated upon at the Hospital for Ruptured and Crippled since 1890 and the cases operated upon outside of that institution by Doctors Coley and Hoguet The total number of cases under consideration is 8589 Of these, 6090 were operated upon at the Hospital for Ruptured and Crippled by Drs Wm T Bull, William B Coley, John B Walker, Wm A Downes, C G Burdick, D H M Gillespie and Of the remainder, 1966 were operated upon by Doctor Coley and Doctor Downes, and 595 by Doctor Hoguet in hospitals other than the Hospital for Ruptured and Crippled By giving the details of this large number of cases we believe we can demonstrate the efficiency of certain operative methods of treatment in certain types of hernia, as in all these cases a certain very definite operative technic was closely followed by the operators mentioned above As can be seen from the accompanying tables, all types of herma are included in the series and the patients were operated on at all ages, so that in every way the series is very wide in its scope efforts have been made to keep in touch with patients after operation large number report back at certain regular intervals and postal card inquiries are addressed to all at yearly intervals. We therefore think that we have traced the larger number of the recurrences that have occurred among our cases

Lack of space will not permit any reference to the older methods of operation for the radical cure of inguinal hernia, which were largely abandoned with the advent and early adoption of Bassini's method in 1890 and the years immediately following

Of the various methods brought out since 1890, the majority have been more or less modifications of the Bassini method, and the more they have departed from the underlying principles of Bassini's method, the less satisfactory have been the results. The Halsted operation originating almost simultaneously with, though independently of, the Bassini method, resembling it in the main features—the transplantation of the cord and suture of the internal oblique muscles to Poupart's ligament—while a great improve-

<sup>\*</sup> Read in abstract before the American Surgical Association, June 8, 1918

ment on the methods which preceded it, had certain disadvantages which did not attach to the Bassini method, and it soon gave place to the typical Bassini operation

Among the other methods that came into vogue shortly after the Bassini method, and which proved so efficient that they are still regarded as methods of choice by many surgeons at the present time, may be mentioned the so-called Ferguson method (Chicago) and the Wyllis Andrews method Both of these methods closely resemble Bassini's method in many respects, the Ferguson method being practically identical with the Bassini method, with the step of the transplantation of the cord omitted. In the Andrews method, not only the transplantation step is omitted, but a special method of applying the overlapping principle originally outlined by Championniere is made use of in closing the canal

All of these methods embody the main principles of the Bassini operation—namely, the long external incision parallel with Poupart's ligament over the centre of the inguinal canal, with free splitting up of the aponeurosis of the external oblique. This latter important step for the first time made it possible to expose clearly the internal ring and permit complete removal of the sac at or beyond its neck, thereby obliterating any funicular process of peritoneum which might favor the early recurrence of the hernia. The second important principle of Bassini's operation is also included in these modifications. The suturing of the internal oblique, and sometimes the external, to Poupart's ligament. The transplantation step was believed to be an unnecessary part of the technic and of little value, and therefore omitted.

Good, even excellent, results were obtained by many surgeons who adopted these modifications of Bassini's method

We think it might be wise to give a brief description of the exact technic of the different operations as performed by us

Ingumal Herma (indirect) —First, an incision  $2\frac{1}{2}$  to 3 inches long (or 3 to  $3\frac{1}{2}$  inches in adults) is made parallel with Poupart's ligament and about  $\frac{1}{2}$  inch above it, so that the lower end of the incision comes directly over the centre of the external ring

Second, the aponeurosis is slit up a distance of  $2\frac{1}{2}$  to 3 inches in the direction of its fibres—in doing this it is important that the director should be withdrawn and the aponeurosis cut very carefully so as to avoid severing the illoinguinal nerve which is frequently sacrificed at this step

Third, the aponeurosis is dissected well back on the inner side towards the rectus muscle, giving a full exposure of the internal oblique muscle. On the outer side, the aponeurosis is dissected until Poupart's ligament is exposed to the pubic bone.

Fourth, the sac and cremaster muscle just over the canal and above the external ring are seized with a pair of thumb forceps and lifted up and the muscular fibres pushed aside by means of a pair of blunt-pointed curved scissors. The white tissues of the sac are thus quickly exposed and held by a

pair of artery clamps in the left hand, and with the thumb and fingers of the right hand the cremaster muscle is quickly and easily dissected from the sac and cord

Fifth, the next step is to cut through the layer of infundibuliform fascia which surrounds the sac and cord in common, change the clamp so that it grasps the exposed sac over its anterior margin, then with the thumb and forefinger of the right hand and a piece of gauze the cord is separated from the sac, until the sac occupies a position above the forefinger of the left hand and the cord below The sac is then cautiously opened to determine whether it is empty or contains omentum or bowel If empty the anterior layer is then cut across, the clamps having first been attached to the upper end of the sac The lower end of the sac can then be dissected out if it does not communicate with the tunica vaginalis, if it does, it is dissected down until the testis is reached, a purse-string suture is placed around the distal portion and the remainder removed. The proximal end of the sac is dissected upward until it widens out into the peritoneal cavity At this point the sac is transfixed in the centre with a double No i plain catgut ligature, and then tied off, so that there is no longer any funicular process of peritoneum The cord is then held up by means of a strip of tape and clamp and the first row of buried sutures inserted as follows The cord is held upright and the first suture, of medium-size kangaroo tendon (not too large), is introduced by means of a curved Hagedorn needle through the upper portion of the internal oblique muscle coming across the inguinal canal so that it just touches the lower border of the cord when the latter is held vertically to the plane of the abdomen The suture is passed outward, first picking up the cremaster muscle, and then the shelving edge of Poupart's ligament, and is finally tied

The second suture is placed in exactly the same way, one-half an inch below. The cremaster muscle is included in the first two sutures, thus affording additional strength to the deep layer. The benefit of thus utilizing the cremaster was first pointed out many years ago by Halsted of Baltimore. We believe it to be of considerable advantage.

Four sutures are usually required in adults. The fourth is perhaps the most important suture of the whole operation and is inserted in a special way, as follows. The external oblique is reflected inward and the illonguinal nerve, which up to the present time is held on the inner side by a retractor, is now released and allowed to drop back into its normal place. The reflected portion of the external oblique about one-half an inch above where it meets the conjoined tendon is transfixed with a sharp Hagedorn needle. The needle then crosses over the nerve and picks up the outer portion of the conjoined tendon, crosses over beneath the cord and enters the lower part of Poupart's, close to its attachment to the pubic spine. The tighter this suture is drawn the more room there is for the underlying nerve which can never be compressed. This is essential, as a great deal of neuralgic pain which often follows herma operations is undoubtedly due to this nerve

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having been caught in the sutures When this suture is tied the lower portion of the inguinal canal is completely closed up to the pubic bone. This stitch is not a part of Bassini's original technic, but we believe it has distinct advantages and greatly lessens the number of recurrences.

Another modification in the Bassini method, which we have used the last twenty-five years, is inserting one suture above the cord, passing it through similar structures to those below, making a new internal ring exactly sufficient for the cord to pass through without undue constriction, and, on the other hand, of sufficient size not to favor a recurrence. The aponeurosis is then closed from above downward by means of a continuous suture of fine kangaroo tendon, leaving just sufficient space at the lower end for a new external ring through which the cord emerges

The operation for inguinal hermia in the female is precisely the same as the operation we have just described, except that the round ligament is preserved and not transplanted

Femoral Herma—The method employed in practically all cases of femoral hernia has been the simple, so-called pursestring, operation, consisting of first a very thorough removal of all the overlying fat which, in many cases of femoral hernia, completely surrounds the sac and makes it somewhat difficult to find the latter Second, a very thorough freeing of the sac, pulling it down so that it is possible to place the ligature well beyond the neck, and finally, the closure of the femoral canal by means of a pursestring suture of kangaroo tendon. Using a curved Hagedorn needle the suture is placed as follows The needle is first passed through the inner portion of Poupart's ligament or the roof of the canal, then downward, taking firm hold of the pectineal fascia and muscle, then outward through the fascia lata overlying the femoral vein, and finally upward, emerging through the roof of the canal about one-quarter inch distant from the point of entrance When this suture is tied the floor and the roof of the canal come into easy apposition and the femoral opening is completely obliterated

Umbilical Herma—The Mayo method of overlapping was adopted at the Hospital for Ruptured and Crippled soon after it was published in 1898, and our results, we believe, show it to be superior to all other methods

The main principles of the operation are

I Transverse elliptical incision, including the umbilicus and, in very obese people, a considerable amount of redundant skin and underlying fat This incision is carried down to the aponeurotic layer. Instead of incising the sac over the distal or most protuberant portion, the opening is made near the neck of the sac, or, rather, just outside of the aponeurotic ring from which the sac emerges. The reason for this is that in most cases of large umbilical hernia the sac contains great masses of irreducible omentum which are apt to be adherent to the distal portion of the sac, while the sac in the neighborhood of the aponeurotic ring is quite free from adhesions. Hence, if the incision is made at this point, there is no danger of injuring the contents of the sac

2 If adherent omentum is present within the sac, it is freed from these adhesions and removed, care always being taken to tie it off in very small sections with catgut ligature. The fascial ring of the sac is then enlarged on either side by a transverse incision, the overlying fat is carefully dissected from the anterior surface of the aponeurotic layer for a distance of 2 to 3 inches. The wound is then closed by a series of interrupted mattress sutures of medium-size kangaroo tendon or with chiomicized catgut, placed in the following manner.

A Hagedorn needle with kangaroo tendon of medium size pierces the upper flap I to 2 inches from its margin, passing through the entire thickness of the aponeurosis and peritoneum and then transversely through the whole thickness of the lower flap about ¼ inch from its maigin, on retuining it is passed through the under surface of the upper flap, the same distance from the margin and I¼ inches distant from the point of entrance A sufficient number of sutures are passed in this way to completely close the opening. It is advisable to insert all the sutures before tying any When these sutures are tied, the upper flap will overlap the lower I½ to 2 inches. The edge of the upper flap is then fastened with a continuous suture to the anterior surface of the underlying lower flap. This makes a firm double barrier to guard against recurrence.

Undescended Testes — The method of operation in cases of undescended testis consists in free incision of the external oblique—as in the Bassini method of operation The sac in all cases of undescended testis is extremely thin and the dissection must be made with great care. After the sac has been cut across, just above the testis, it is freed well up beyond the internal ring and tied off as high as possible The lower end of the sac is sutured over the testis, making a complete tunica vaginalis. The next step is to remove all the fascial bands which surround the veins been done, it is usually possible to bring the testicle into the sciotum the few cases in which it is not possible, the majority of the veins may be resected, leaving a little more than the vas and the spermatic vessels step was advocated by Doctor Bevan many years ago, and has proved of very great value In a very small number of cases gangrene of the testis is reported to have occurred, but we have not seen it in our experience It should never be used as a routine measure, but only in the rare cases described The cord is never transplanted, but allowed to drop back in the lower angle of the wound, the internal oblique is sutured to Poupart's ligament, exactly as in inguinal hernia in the female. We do not suture the testis in the scrotum as advocated by many surgeons

In the majority of our cases the testis has remained in the lower or middle scrotum, but in a considerable number it has retracted to the region of the external ring. In a few cases in which the testicle was of normal size at the time of operation, it continued to develop in the normal manner after operation, but in the cases in which it was more or less atrophied at time of operation, it failed to increase in size after operation. In only two

cases was the testis removed at the time of operation. It was so atrophied that it was almost impossible to recognize any testicular elements. Whether or not the undescended testis is of functional value, is a problem which has not yet been settled. There are a few cases on record of patients with double undescended testis, that apparently have been able to produce children

There have been no deaths in this series of 441 cases and no herma has thus far been known to follow the operation

The results in this group of cases might be used as an argument in favor of not transplanting the cord in the ordinary inguinal hernia in the male. However, it is hardly fair to draw this inference, for the reason that in the great majority of these cases the hernia was rather a potential one, than an actual hernia, being merely an open process of peritoneum, communicating with the abdominal cavity and tunica vaginalis

Direct Herma—Far back in the early days of radical operation it was recognized that it was much more difficult to effect a permanent cure in direct inguinal herma than in the oblique type—Special modifications of technic have been devised to meet these difficulties—Wolfier in 1892 introduced a somewhat complicated technic in which the rectus was turned out of its sheath anteriorly and sutured to Poupart's ligament—Bloodgood in 1898 published a modification of Wolfier's method and later advised opening the rectus sheath from behind—For many years we have held to the belief that the transplantation of the rectus muscle is almost essential to a permanent cure in direct inguinal hermic, particularly those of large size, and in our opinion the method described by Dr William A Downes (Annals of Surgery, 1911, vol lii, p 568) is the best thus far proposed for utilizing the rectus muscle—Unlike Slajmer, we believe transplantation of the cord is not only the method of choice in oblique inguinal hermia but of even greater importance in cases operated upon for direct inguinal hermia

The method of operating on direct hernia as advocated by Doctor Downes is briefly as follows. First, removal of the indirect and direct sacs, with division of epigastric vessels, second, the internal oblique and transversalis are held up by a small blunt retractor placed at the internal ring, and these muscles are followed, down and in, until they join the transversalis fascia at the outer margin of the rectus The sheath of the rectus formed by these structures at this point is opened, and the muscle is exposed down to its pubic attachment By means of three sutures of kangaroo tendon the outer margin of the rectus muscle is sutured to Poupart's ligament. The sutures are placed from below upward, and about one-half to three-quarters of an inch apart In some cases four sutures are necessary After this row of sutures has been completed the retractor is withdrawn and the usual Bassini operation performed from above downward, the internal oblique muscle being sutured to Poupart's ligament The sutures in this case are just superficial to and between the first row The external oblique is then closed in the usual way There are three distinct layers instead of two as in the operation for oblique hernia The cord is always transplanted and the cre-

master if not too thin is included in the sutures uniting the rectus with Poupart's ligament. Up to the time of his report Doctor Downes had performed the operation in 50 cases of direct hernia, 10 had been traced for more than one year, having no relapses

Further observation has, however, shown a certain number of relapses in the cases of Doctor Downes, and at present he is inclined to believe that as high a proportion as 10 per cent of recurrences will be found even after this method, if the cases are traced to final results. In our own series Doctor Downes' technic has been employed only in a limited number of cases. Our aim has been to bring over to Poupart's ligament the anterior portion of the rectus muscle and rely upon the special stitch which we have already described for closing the lower portion of the canal, which includes the reflected portion of the external oblique. This avoids the extra layer of suture to Poupait's ligament in Downes' technic. In many cases Poupart's ligament is so poorly developed and easily torn that the insertion of two layers may weaken the structure upon which we most rely for our repair of the canal.

Within the last twelve months one of the writers (Hoguet) has discarded this method of operating on direct hernias, and is trying out a new one which differs in several essential points. The indirect sac which, although very small in some cases, practically always exists, is first separated from the cord and opened The deep epigastric vessels are not divided, but by traction outwards on the indirect sac, practically all the peritoneum of the direct sac can be pulled externally to the deep epigastric vessels method of treatment the danger of injuring the bladder when the direct sac is opened is obviated Instead of suturing the rectus down to Poupart's ligament, the deep sutures are introduced in the manner described for the innermost suture in the Bassini operation, that is, instead of grasping only the conjoined tendon, this structure together with the reflected portion of the aponeurosis of the external oblique is included within the deep sutures, the cord, of course, being transplanted Over this the cut edges of the aponeurosis are sutured, anterior to the cord None of the cases operated upon by this method have recurred up to the present

In spite of the most careful technic the proportion of recurrences in direct herma will always be considerably greater than in the oblique variety. One of the chief reasons for this lies in the fact that most cases of direct herma occur in adult males with poorly developed abdominal walls and, especially, poorly developed internal oblique muscles. If the final results of the patients who have been operated upon for direct herma are carefully followed up for at least a period of two years after operation, we believe that fully 10-15 per cent will show a distinct recurrence

Suture Material —There is one very important point of technic which has an equal bearing upon all methods of operation for the radical cure of hernia and that is the material used in the buried sutures. Upon this factor often depends the success or failure of the operation. At the Hospital for

Ruptured and Crippled we have had an unusual opportunity for observing the end results of many methods of operation and as early as 1890 to 1895 we began to see the increasing number of cases in which the disadvantages of using the non-absorbable sutures became very apparent. Since that time in the annual review of Hernia for Progressive Medicine Coley has repeatedly called attention to these disadvantages and strongly urged against the further employment of non-absorbable sutures and buried sutures In the early days, or twenty-five years ago, there was some excuse for their use because of the difficulties attending perfect sterilization of absorbable sutures However, since those days it has been possible to obtain entirely reliable sterilized kangaroo tendon or chromic catgut And there has been no further legitimate reason for the use of non-absorbable sutures in hernia suture that lasts more than three weeks is a disadvantage rather than an advantage, masmuch as if there be any tension at the end of this period the suture will cut through until the tension ceases to exist, when it will remain either as a harmless foreign body or, as is the rule in a not inconsiderable number of cases, will give rise to chronic irritation ending in an open sinus which persists until the foreign body has been removed. That these objections are not merely theoretical has been proven by a long series of observations One of the most noteworthy cases illustrating this point was observed at the Hospital for Ruptured and Crippled in 1890, in which a silkworm suture had been used in a Bassini operation for inguinal herina in an adult man, six months before, and the wound had healed by primary union At the end of this time a sinus formed and a suture was removed and the wound healed He remained well for about two years, when another sinus appeared, another suture was removed, and the patient remained well until three years and eight months later, when a third sinus formed, at which time the last of the sutures was removed In addition to the discomfort attending these various periods of sinus formation, the long continued suppuration with the consequent scar tissue served to produce a relapse of the hernia

In spite of the fact that such results have been frequently published and are generally known, silkworm sutures are still used in operations for the radical cure of hernia by some of the most distinguished surgeons here and abroad Only a year ago a patient was sent to us for a sinus in the right groin and another one in the left upper scrotum, with the history, that, about a year before he was operated upon for a hernia and varicocele at one of the most prominent English clinics The patient was told that in five weeks he would be ready for military service. At the end of five weeks a sinus appeared and remained open for about six months, and he was told he would never be able to go into the army, so he came to America The induration in the left scrotum with sinus formation so closely resembled tuberculosis that this diagnosis was made in one of the out-patient departments in New York It was not difficult to make a diagnosis that buried or non-absorbable sutures were responsible for his condition The sutures were removed and the sinuses promptly healed, but not until the young man

had been more or less of an invalid for nearly a year and until he had lost all opportunity of entering the army. The matter is so important that we have felt justified in again referring to it at such length

From December, 1890, to January, 1918, 6090 operations for the different varieties of hernia have been performed at the Hospital for Ruptured and Crippled The great majority of these operations were performed by a small group of surgeons—Doctors Bull, Coley, Walker, Downes and Hoguet, a small number by the assistant surgeons or house surgeons under our direct supervision

#### VARIETIES AND RECURRENCES

	Cases	Recurrences	Per cent
Inguinal in the male, oblique	4420	25	57
Direct hernia, male	33	0	0
Inguinal in the female, children	690	I	15
Inguinal in the female, adults	369	13	3 5
Direct hernia, female, adults	13	I	77
Femoral hernia in children	69	O	0
Femoral herma in adults	182	8	4 4

Four of these recurrences were in cases in which the operation was done for recurrent hernia, the primary operation having been done by other surgeons. They should, therefore, not really be included

Umbilical hernia, children	58	0	0
Umbilical hernia, adults	104	3	28
Ventral herma, children	24	0	О
Ventral herma, adults	81	12	148

Note.—Most of these were large ventral hermas in stout women, following old laparotomies

Epigastric hernia	18	I	5 5
Lumbar hernia	I	0	0

In 334 cases the operation was for undescended or maldescended testis. In practically all cases, with 3 or 4 exceptions, there was a hernia, either actual or potential, that is, an open funicular sac communicating with the tunica vaginalis.

It is noteworthy that not a single relapse has been observed in these 334 cases of operation for undescended testis

Methods of Operation—The typical Bassini operation, or the Bassini with slight modifications which have been described, was performed in inguinal hernia

Ingunal Herma—	Cases	Recurrences	Per cent
Bassını	3725	14	38
Cord not transplanted	792	II	13
Direct inguinal hernia, Bassini	24	0	0

Note—It should be stated that these cases of direct hernia all occurred in adult females and in children under the age of fourteen years

	Cases	Recurrences	Per cent
Transplanting rectus	8	0	0
Femoral Herma—			
Femoral, children	69	O	0
Femoral adults	182	8	31

Note.—It should be noted that four of the recurrences were in operations for recurrence

The pursestring suture with kangaroo tendon was used in nearly all the cases, after a very high ligation of the sac and the removal of all the overlying fat

Umbilical Herma—	Cases	Recurrences	Per cent
Umbilical hernia, vertical overlapping	34	2	58
Umbilical hernia, transverse or overlapping	77	I	18

A study of the time of the recurrence, ie, the interval between operation and the time that the recurrent hernia was noted, is of very great interest and importance. In 4453 cases of inguinal hernia in the male, 25 recurrences were observed, and of these 13 occurred within six months to one year after operation, three within one to two years. The other cases recurred at longer periods after operation. I after three and one-half years, 2 after seven years, 2 after three years, 1 after four years, 1 after fourteen years and 1 after twenty years.

Mortality — The mortality has changed very little since the earlier statistics. From December, 1890, to January, 1901, a period of ten years, 2732 cases were operated upon at the Hospital for Ruptured and Crippled, with six deaths, or 22 per cent. From January, 1901, to January, 1918, 3358 were operated upon with five deaths, or 15 per cent. The later deaths referred for the most part to cases of large irreducible strangulated umbilical hernia. They were as follows

End Results —With regard to the end results of the first period, we find 15 recurrences in 2029 cases of inguinal hernia in the male, or 73 per cent in the cases operated upon by the Bassini method, and 428 per cent in the small group of cases operated upon by Czerny's method

In the second period, from 1901 to 1918, covering 220 cases, there were only 10 relapses or 45 per cent

CASES OF INGUINAL HERNIA OBSERVED AT THE HOSPITAL FOR RUPTURED AND CRIPPLED

		AGE								
	Under 1 yr	1-4	5-9	10-14	15–19	20-29	30-39	40-49	50-59	60~
Male	4	790	1929	833	34	18	28	7	7	3
Female		86	322	150	60	84	86	47	18	18

In this series, as far as it has been possible to trace, 1667 cases have remained well from one to four years, 586 cases have remained well from five to nine years, 193 cases have remained well from ten to fourteen years, 46 cases have remained well from fifteen to nineteen years, and 14 cases have remained well from twenty to twenty-six years

Of 216 cases of femoral hernia, 169 have occurred in adults and 47 in children under the age of fourteen years. Ninety-nine cases have been traced in which the patients have remained well from one to twenty-four years after the operation, and in the entire series 14 recurrences are known to have taken place.

Of 166 cases of umbilical hernia, 118 occurred in adults and 48 in children, of the latter, 21 occurred in males and 27 in females. In 66 cases the patients are known to have been in good condition from one to eleven years after the operation, and in 25 cases for more than three years. Nine recurrences have taken place and 5 deaths—among the deaths was one case, a female forty-four years of age, in which an extensive operation for carcinoma of the ovary was performed in addition to the hernia operation, and the patient died four days later

Of 103 cases of ventral hernia, 86 occurred in adults and 17 in children In this series 41 have remained well from one to fifteen years, the remainder not having been traced, and 11 recurrences have taken place

Of 15 cases of epigastric hernia, 12 have occurred in children under the age of fourteen years, and the remainder in adults. Six cases are known to have been well from one to seven years after the operation, and in two cases a recurrence took place

Direct Inguinal — There have been observed at the Hospital for Ruptured and Crippled, 54 cases of direct hernia, including 4 doubles, making a total of 58 cases of direct hernia Of these, 37 cases occurred in adults (21 in females and 16 in males), and the remainder in children under the age of fourteen years As regards the sex in the latter, all occurred in males with one exception These figures, however, do not represent the actual relative porportion occurring in the two sexes. It is only the last year that adult males have been admitted to the Hospital for Ruptured and Crippled hernia in the female is extremely rare and the relative proportion is more accurately shown in our statistics elsewhere The final results in this list of 58 cases is of interest. In only one case is a recurrence known to have taken-place This case was complicated with a separate interstitial sac coming out of the internal oblique external to the internal ring and not connected with the round ligament, a recurrence took place seven months after the operation Of the cases that have been traced, 18 have remained well from one to eight years

The final results in the cases of undescended testis will be given in detail in a separate paper. A brief summary of the cases observed at the Hospital for Ruptured and Crippled is as follows

Of 314 cases of undescended testis only 10 occurred in adults over the age of fourteen years. As far as can be traced 123 cases have remained well from one to twenty-one years after the operation, 64 cases over three years, and 14 cases over ten years. It is interesting to note the position of the testis in these latter 14 cases. In one case, well twenty-one years, the testis was atrophied, in another, well thirteen years after, the testis was not

felt, in another, well fourteen years, the testis was outside of the external ring, and the size of a hickory nut, in another, well eleven years, the testis was not felt, in another, well eleven years, the testis had disappeared, in one case, well twelve years, the testis was normal in size and position, in another case, well twelve years, the testis was small and at the spine, and in another case, well twelve years, the testis was in the channel, in one case, well eleven years, the testis was atrophied and lying on the external oblique just above the external ring, and so on. In the 2499 cases operated on outside the Hospital for Ruptured and Crippled, there were 107 cases of undescended testis.

This large group of cases should throw some light upon the important question of whether the trauma connected with bringing the testis into the scrotum by operation favors the development of malignant disease. As far as we have been able to determine, in no single case in our series has the patient afterwards developed a sarcoma of the testis. One of the authors, however (Coley), has observed a case of sarcoma in an undescended testis shortly after an operation had been performed for bringing it into the scrotum. The patient was operated upon in another city and it is impossible to state positively that the disease had not been fully developed before the operation, although, in all probability, in this case the trauma connected with the operation may have been an exciting factor.

Strangulated Herma -Of the 31 cases of strangulated herma observed at the Hospital for Ruptured and Crippled, it is interesting to note that the majority occurred in children under the age of two years. The youngest case was a child thirteen days old, with a loop of small intestine fourteen hours strangulated A Bassini operation was performed and the patient was well when last traced, many years later Seven of these cases were under one year of age, and to under two years It is especially worthy of note that the only death in this series occurred in a woman fifty-one years of age, with a very large strangulated umbilical hernia The only recurrence which took place was in a woman thirty-five years of age with a very large strangulated umbilical hernia which was complicated by a seven months' pregnancy A hernia operation was performed and was followed by severe suppuration of the wound, which, together with the unusual strain of child-birth coming on two months later, favored a recurrence of the hernia, which took place eight months after the operation Thirteen of these cases traced were found to be free from recurrence from one to twelve years after operation

Contents of the Hermal Sac — The cæcum alone and with the appendix was found in 27 cases, in one case there was a slight relapse one year after the operation, of the remainder as far as were traced 12 remained well from one to twenty-one years after the operation

The appendix was found in the hernial sac in 39 cases. In all but three of these, the age of the patient was under fourteen years. In 8 of the earlier cases the appendix was not removed, but in the remaining 31 cases the appendix was removed at the time of operation.

The ovary and tube were found in 9 cases, the tube alone in 4 cases, and the ovary alone in 4 cases. One case of special interest is that of a woman thirty years of age with a double strangulated hernia in which a strangulated (fallopian) tube was found in the right femoral sac, the patient was well and free from recurrence when last traced, eight years after the operation

In 17 cases the bladder was found in the sac, 10 of these cases occurred in children under the age of fourteen years, and 7 in adults between the ages of twenty-five and sixty-five years. In every case, with one exception, the bladder was recognized before it had been opened. This particular case occurred in a woman thirty-seven years of age with a left femoral herma, the patient made a good recovery without complications.

Seven cases of tuberculosis of the hermal sac were found, in all of which the diagnosis was confirmed by pathological examination. One of these cases died of tubercular peritonitis some time after, I was well four years later, and the remaining cases were not traced

The results at the Hospital for Ruptured and Crippled have been often criticised as not furnishing a true criterion of the value of the radical operation for hernia, because so large a proportion of the cases have been in children under the age of fourteen It is assumed without debate that it is much easier to effect a cure of hernia in children than in adults though our statistics at the Hospital for Ruptured and Crippled prior to 1890, when the older methods of Czerny and Socin were employed, show practically the same proportion of recurrences in children as in adults, we believe that children and young adults are more favorable subjects for operation than older people. In order to throw further light on this question. we have included 2499 cases of adults operated upon by Doctors Coley and Hoguet outside of the Hospital for Ruptured and Crippled and in Doctor Coley's service at the Memorial Hospital by Dr Wm A Downes, of these 2499 cases, 1383 were operated upon by Coley and Downes, 595 were operated upon by Hoguet, and 521 were operated upon by Coley

Age of Patients, Including Males and Females	S
Under 5 years	54
5-10 years	31
10–20 years	394
20-30 years	889
30-40 years	549
	358
50–60 years	170
60-70 years	54
Total 2	499

Inguinal hernia in the male—oblique	1855
Inguinal hernia in the female—oblique	182
Inguinal hernia in the male—direct	252
Inguinal hernia in the female—direct	
Femoral herma	IOI

#### COLEY AND HOGUET

Umbilical hernia	65
Ventral hernia	32
Epigastric hernia	7
	2499

Among the local sequelæ following radical operations for hernia are hydrocele and orchitis. Among the general sequelæ bronchitis, pneumonia, phlebitis, intra-abdominal swelling due to inflammation of omental stump and embolism.

We believe that the local sequelæ are in direct proportion to the experience of the operator. If great care is exercised in dissecting the sac from the cold with a minimum of trauma, the larger vessels tied before cutting and the small bleeding points controlled by ligature, hydrocele, orchitis, or local swelling will very rarely be observed. We always support the testis by a little shelf or platform made of adhesive plaster placed across the upper portion of the thigh. Following operations for herma we have observed (?) cases of pneumonia undoubtedly due to the anæsthetic

The frequency with which thrombosis and embolism is the cause of death in abdominal operations is brought out by E H Beckman (Annals of Surgery, May, 1913) and L B Wilson (Annals of Surgery, December, 1912,), both of the Mayo Clinic Wilson states that during the period from 1899 to 1911, inclusive, 63,575 major operations were performed with 47 cases of fatal post-operative embolism, these fatalities representing 5 per cent of the total number of deaths from all causes

It is somewhat remarkable that thus far there have been no deaths from embolism in our series of 6500 operations performed at the Hospital for Ruptured and Crippled

In 1383 cases operated upon at the Memorial Hospital by Doctors Coley and Downes, there were two deaths—In the first case, a male thirty-five years of age, operated upon by Doctor Coley, a large mass of omentum was replaced with some difficulty and probably considerable trauma—The patient died on the fifth day with gradually increasing distention and signs of peritonitis—The second case, operated upon by Doctor Downes, died of infection and peritonitis—In a third case operated upon by Doctor Coley at the Memorial Hospital—a very large irreducible umbilical hernia in a stout woman—death occurred—It was found almost impossible to reduce the contents of the sac into the abdomen and when reduced respiration became difficult—The patient died two days later of heart failure, no evidence of sepsis—Another death occurred in a case operated upon at the Post-Graduate Hospital by Coley in 1895, in a strangulated femoral hernia with resection of the bowel

Doctor Hoguet's series shows 6 deaths two males, one a strangulated indirect hernia with general peritonitis present at time of operation, and the other a simple indirect acute, with atrophy of the liver, and four females, one a strangulated femoral, no resection, shock, another, a strangulated femoral, after gut resection, another, a direct inguinal, acute nephritis, and the fourth, a ventral with pulmonary embolism

# LIPOMA OF THE FUNICULUS SPERMATICUS

By Heliodor Schiller, M.D. of Chicago, Ill

LIPOMATA in the wake of the inguinal canal are common Kellogg Speed found in 154 hernial operations 75 lipomatous growths which had their origin in the properitoneal fat. They spring from the subserous fat around the margin of the internal ring, singly or several of them, and if enlarging grow along the inguinal canal, distending it, and often follow the cord as far as the sciotum. They vary in size up to many pounds, have at times a distinct peritoneal-like capsule, are in many cases the predisposing cause of hernia, not only by distending the internal and external rings and inguinal canal, but because they will, by propulsion, produce an infundibulum in the peritoneum and thus a hernial sac. Mention should also be made of the fatty hernias, in which the sometimes small hernial sac is enveloped by thick masses of fatty tissue.

The true lipoma of the cord is a rare tumor and originates from fat lobules within the tunica vaginalis communis of the cord around its different organs. Small fat lobules within the cord are sometimes to be seen macroscopically—in 22 cases which Hutchinson examined in this direction, he could find small fat lobules in 11 cadavers—microscopically fat tissue can be detected within every cord. The size of the lipomata varies from a small tumor to an enormously large growth. It may extend proximally up to the internal ring, ending there sharply or connecting intimately with the properitoneal fat. Distally it may grow as far as the scrotum and by breaking through the tunica vaginalis propria, as far as the epididymis and testicle, and attain great size. A few cases are reported where the lipoma broke through the tunica communis and connected with the fat of the subcutaneous tissue, in this way disguising the real origin.

The pathologic anatomical differential diagnosis between the true lipoma of the cord and the common lipoma of the subperitoneal fat in their early stages is simple, but later on often impossible. If small and well encapsulated there can be no doubt of their origin, but if the lipoma is large, even a wide exposure will not assist. Theoretically the lipoma of the cord should always be surrounded by the tunica vaginalis communis, it should derive its main blood supply from the vessels of the cord, while lipomata from the properitoneal fat always should show a close connection with this layer and should get its blood supply from there and should lie outside of the tunica vaginalis communis. But the true lipoma of the cord will often break, in the course of its growth, through the tunica communis, especially in the proximal part of the inguinal canal, where the cord normally is spread, will connect there so closely with the subserous fat that it appears a lipoma of it

#### HELIODOR SCHILLER

Clinically there are, depending on the size and location, all the symptoms of a hernia, respectively omental hernia, a soft tumor in the inguinal canal or extending down in the scrotum, showing impulse on coughing, enlargement in the erect position, a tumor which can partly be replaced into the abdomen. If the lipoma grows more toward the scrotum, a hydrocele, hæmatocele, teratoma, tumor of the testicle, cyst of the cord, hydrocele of the funiculus have been mistaken. Their consistency differs from pseudofluctuation to rather hard tumors, depending on the amount of connective tissue present. For the surgeon it is well to remember that the lipoma of the inguinal canal often contains a peritoneal sac, also to remember the fat hernia with a comparatively small hernia sac and a great accumulation of fat around it. The small sac might hardly be detectable and nevertheless contain an abdominal viscus.

The treatment is surgical After removal of the lipoma, it will be advisable to finish the operation with a radical operation for hernia. Pressure and traction causes these lipomata gradually to distend the rings or the inguinal canal, thus predisposing to or actually producing a hernia. Therefore the radical operation becomes a necessity

A man, forty years old, tall, heavy-210 pounds-always well, noticed for over a year a slow-growing swelling in his right inguinal region, which was diagnosed as a hernia. For the last six weeks it gave him discomfort. The examination showed a healthy man with well-developed panniculus adiposus. In his right inguinal canal and extending down in the scrotum is a sausage-like, soft tumor enlarging the scrotum twice the size of the other side, the tumor, enlarging in the erect position, shows impulse on coughing, but cannot be entirely pushed into the abdomen, this attempt is painful. After incision of the skin, subcutaneous fat, superficial fascia, the fibres of the cremaster could be seen spreading over the supposed hernia After separating them bluntly a well-developed membrane, like the peritoneum of a hernial sac, could be made out, and shining through it a large mass of fat extending into the scrotum. This whole mass and sac could easily be enucleated from the scrotum. After incising the membrane doubt arose that we were dealing with an omental hernia, large fatty lobules grew around the vessels of the plexus, spreading the contents of the cord like a fan. carrying them on its medial side, while in the proximal part of the canal the fatty mass ended rather abruptly, surrounded by a well-defined. capsule, only a few strings of connective tissue connecting it with the subperitoneal fat The contents of the cord were finally separated from the lipomatous mass, several blood-vessels connecting with the plexus had to be ligated and, as the inguinal canal was left very wide, no peritoneal bulging could be noticed—and as the abdominal muscles were widely separated from Poupart's ligament, an Andrews' operation was performed The specimen shows a lipoma 61/2 inches long, the circumference of the upper end 4, and of the scrotal part 6 inches,

# LIPOMA OF THE FUNICULUS SPERMATICUS

having the character of the lipomata of subcutaneous fat The above described anatomical findings make the diagnosis of a true lipoma of the funiculus spermaticus certain

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# FECAL FISTULA FOLLOWING STRANGULATED HERNIA, WITH REPORT OF FIVE CASES OPERATED UPON

By WILLIAM D HAGGARD, M D
OF NASHVILLE, TENN

Practically all cases of strangulated hernia unrelieved by operation invariably terminate fatally from peritonitis or shock. A small proportion, however, generally estimated at about 5 per cent, recover. In rare cases the destructive process will penetrate the sac and skin, and the patient will recover with a fecal fistula and artificial anus. Adhesions doubtless form between the strangulated loop of intestines and the wall of the sac. The hernial protrusion becomes red, tense and sensitive. Compression anæmia of the intestine plus infection of the damaged loop results in gangrene and rupture, and the abscess finally ulcerates through the hernial sac and integument. Meanwhile the entire process has been walled off from the general peritoneum and self-cure is obtained by external perforation without peritonitis.

Five such cases have occurred in my service. Four were women, of whom two were middle-aged and two were elderly, the other was a boy of six. Three were femoral and two were inguinal. The period preceding perforation was from ten days to two weeks. Two ruptured spontaneously, and three were opened for the resulting abscess. All drained fecal matter. Two healed naturally in four and five weeks respectively after evacuation of the abscess, two after freshening the margins of the opening, and one required abdominal section with detachment of the intestinal loop from its entrapped position in the femoral ring and suture of the opening. All recovered

Case I — About twenty years ago Doctor McClarny, of Crossville, Tenn, sent a large fleshy woman to me with a fecal fistula in the right groin It had been discharging three or four months. There was a history of a femoral hernia for some years, for which a truss had been The hernia had become strangulated and living across the mountain she was unable to obtain surgical or other attention great suffering the herniated mass became exquisitely tender and at the end of two weeks ruptured spontaneously The contents of the bowels escaped at the site for some months when she was sent to the hospital for relief About that time we were having a number of persisting biliary fistulæ after operation on the gall-bladder, as we were sewing the gall-bladder to the abdominal fascia. They were readily cured by making a circular incision around the margins of the fascial opening, allowing granulations to form between the freed margins of the gallbladder that had been liberated from its attachment to the fascia idea was utilized in this case, with prompt and satisfactory healing

CASE II —A lad of six awakened crying with pain, and told his mother that the knot had come back in his side Eighteen months before, the hernia had been irreducible for about a week, but there were no obstructive symptoms then or later There were swelling, pain and vomiting Normal defecation occurred on the first and second days and purgatives were given, and acted on the third and fifth days Pain was considerable and the boy was confined to bed Temperature appeared on the second day and continued The swelling gradually Topical applications were made, and on the seventh day it was poulticed. On the following day it appeared red and looked like an abscess, ready to be opened On the ninth day Dr W T Green, of Big Rock, Tenn, incised it Considerable pus escaped and then several ounces of liquid fæces ran out The little boy was brought to St Thomas Hospital on the seventeenth day (January 16, 1913), where the incision in the right inguinal region was enlarged and what appeared to be a sphacelous knuckle of intestine about two inches in length was lifted out

The fecal fistula remained for about four weeks and closed spontaneously. The boy has been quite well since

CASE III -A woman, Mrs Joe A, sixty-three years of age, entered the hospital December 7, 1916, with a discharging sinus and fecal fistula in the left groin of three months' duration. At that time she had noticed a slight femoral enlargement about the size of the end of the thumb Within a few months she had two attacks of general abdominal pain with nausea, vomiting and constipation, followed by soreness and tenderness over the abdomen for several days months ago she was seized with vomiting, cramping pains in lower abdomen, followed by a chill, fever and sweat Vomiting persisted for forty-eight hours No bowel action for five days, abdominal pain the while, with visible peristalsis The femoral enlargement increased to the size of two fists At the end of two weeks the tender mass ruptured and discharged a large quantity of pus which was later followed by fecal material This continued until two weeks ago, since which time the discharge was pus in moderate amount. Forty years ago she had a number of pulmonary hemorrhages, and has lived in Montana on that account with great improvement. There had been no hemorrhages for fifteen years

The patient was kept in bed some two weeks and the sinus closed. She left the hospital and shortly the sinus reopened. Within two months she gained thirty pounds. The sinus alternately appearing to almost cease and then drain most profusely for a number of days. For several weeks peristals was noticeable and at times very active. Following a very severe attack of cramping, operation was advised for adhesion at the site of the former femoral fecal fistula. An incision in the left semilunar line disclosed the convex surface of a loop of small intestine firmly drawn into the femoral opening and densely adherent therein. It was separated with difficulty and the resulting rent at the site of the previous Richter's hernia with perforation was closed with two layers of silk. Recovery was complete.

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#### WILLIAM D HAGGARD

Case IV —On the night of December 16, 1917, a woman, Mrs C E, fifty-eight years of age (No A 6475), was admitted to the hospital with a very large abscess of the right groin of ten days' duration. The temperature was 102 degrees—The skin covering the abscess was mortified and black over a considerable area—The house-surgeon was about to open it when he discovered that it was tympanitic—When I opened it later, the gas escaped and the greatly distended skin covering collapsed—Some foul-smelling feculent fluid was evacuated—The wound drained fecal matter copiously the next morning and continued to do so for about ten days and ceased completely—The wide-open wound soon became healthy and granulating, and was closed under local anæsthesia on the fifteenth day

CASE V — Mrs V, aged forty-five years, mother of seven children, lived in a sparsely settled community on the Cumberland Plateau She had a hernia which became strangulated on October 1, 1903 Dr A F Richards, of Sparta, was called to see her October 13th, and found her with pulse 140, temperature 1031/2, abdomen swollen to its fullest capacity, and the woman propped in a semirecumbent position. panting for breath Her condition was extremely critical for several hours after the doctor's arrival, pending the use of stimulants and opiates The hernial protrusion had sloughed and ulcerated through the right side, forming a fecal fistula through which gas and fæces poured She gradually improved until November 18th, when the doctor found her with normal temperature and pulse, sitting up in bed. taking nourishment, but still having continuous fecal discharge from the fistula with an occasional normal bowel action This continued until the following January, when I saw her, and opened the external fistulous tract, curetted the sinus and used stimulating applications. after which the fistula healed in about three months. She was seen some three years later by Doctor Richards, and was at that time entirely and completely well

# THE TRAUMATIC ABDOMEN\*

# By JOHN B DEAVER, M D.

OF PHILADELPHIA, PA

THE stimulation to traumatic surgery brought about by the present war has extended to all branches of surgery, but it is essentially apparent in the field of abdominal work, for it is only exceptionally that the abdominal surgeon in civil life has the opportunity of extensive observation of this class of traumatism

It is generally conceded, however, that there is distinction without difference in civil and war surgery of the abdomen. The same principles apply to both, paramount among them being early diagnosis and prompt treatment.

The apparently easy cases are generally the most difficult to diagnose After the initial shock a reaction often sets in, which proves as deceptive to the patient as it is to the surgeon in attendance. Prostration, pallor, anxious facies, thirst, cold, exquisite pain on moving the body, limited abdominal movement on respiration, rapid pulse of low tension, rigidity, dulness in the flanks, vomiting—these are symptoms that leave little doubt of some visceral lesion, but often the picture is not so clear in spite of the presence of serious intra-abdominal injury. And again experience, especially with small particles of shell from an exploding bomb, has shown that one must be careful about making a negative diagnosis. The wound is often so small and insignificant while the velocity of the missile has been very great, that it sometimes takes actual "strength of mind" to explore the abdomen, although the symptoms point to the probability of visceral injury, oftentimes, too, a man hit in the abdomen is quite unconscious of the fact that the intestines are prolapsed

In the early part of this war non-intervention was practically the rule in the treatment of abdominal injuries and the wounded were kept, in so far as this was feasible, as close as possible to the spot where the wound was received. With the perfection of the hospital and nursing service, a complete reversal of this principle was adopted, especially with the establishment of opportunity for prompt surgical attention reasonably close to the front, so important in this class of cases the mortality of which increases rapidly if treatment is delayed beyond twenty-four hours after the receipt of the wound. While operation is now considered the only chance of recovery in the vast majority of cases, though it sometimes represents only a minimum chance, there is a small percentage in which expectant treatment may be justified. These include mainly contour wounds and cases in which the projectile has apparently not traversed the abdomen but has been arrested

<sup>\*</sup>Read before the American Surgical Association, June 7, 1918

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in the immediate vicinity of the peritoneum, causing only reflex peritoneal reaction, abdominal wounds without visceral or vascular lesions, rare though not unknown, and wounds causing unimportant hemorrhage, as in perforation of a solid viscus, such as the liver, spleen or kidneys, and finally a few fortunate small actual perforations of the ascending or descending colon by the development of circumscribed peritonitis and a fistula

With the exception of a few individual so-called "abstentionists" surgeons among our allies have ranged themselves with the "operationists," and to them an abdominal injury means incise, look for the damage and treat it. Even advanced cases of peritonitis and occasionally a pulseless patient have profited by operation when abstention would have meant certain death. The dictum seems to be operate, operate early, operate as near to the front as possible, and make your operation as complete as possible

Shock may be combated by the usual means, but too much time should not be lost in this measure. Symptoms of shock often do not appear during the first two or three hours, except in cases of profuse hemorrhage, or of effusion of intestinal contents into the abdominal cavity, so that shock does not necessarily contra-indicate operation. Moreover, the patients are usually young men whose physical resistance has been developed to a high pitch so that what might be venturesome in civil life proves less so in war conditions.

Interesting studies are being made on the subject of shock and hemorrhage. The importance of the question is evidenced by the appointment of special committees to investigate and coordinate the results of the studies made. From the reports that have thus far been published we gather that, although the underlying etiological factor in the production of symptoms of shock has not yet been determined, existing observations as to bloodpressure and physical changes in the blood have been confirmed and new ones have been brought forth, several groups of cases having been studied almost from the moment of being injured and at various stages before reaching the operating theatre as well as after operation

Without in any way reflecting upon the value and the importance of these studies, I venture to question their practicability at this time, for the traumatic abdomen. Abdominal cases are emergency cases and there is rarely time, nor, I should think, the proper equipment, at the front for making these studies, necessary to decide whether a man is suffering from shock or hemorrhage or both, nor at the present time with the shortage of laboratory assistants in civil hospitals is it always possible to have such studies made

Differentiation of shock and hemorrhage is a very delicate one. It is to be anticipated that the studies of the research committees, already referred to, will furnish very definite conclusions in this regard. The leucocyte count which is increased in hemorrhage and is not apt to be affected by shock often throws some light on the subject. But with the means at present

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at our disposal much depends on the intuition of the experienced surgeon who more often than not makes the differentiation correctly

In the diagnosis of a suspected abdominal lesion pain is of little aid. It varies in degree and there is apparently no direct relationship between its intensity and the extent of the injury. Pulse and the degree of abdominal rigidity are of importance. A man with a pulse of more than 110° is not usually able to withstand prolonged anæsthesia and requires suitable treatment before operation is undertaken. Hemorrhage should always be suspected and then it is the state of the pulse that is often the deciding factor for or against intervention. Abdominal rigidity varies from generalized rigidity over the entire abdomen to a small localized area. The latter often occurs in late cases where a lateral wound has involved only the colon, and a fecal fistula or walled-off fecal abscess has formed. The absence of rigidity is now generally recognized as an unfavorable prognostic sign, since it is usually associated with extensive lacerating lesions of the small and sometimes the large intestine and usually is seen in cases that come under observation from ten to twelve hours after being wounded.

Vomiting, though it forms part of the history of nearly every case of abdominal injury, is not a constant feature, in fact, it is often a prominent symptom where there is no visceral lesion. The same inconstancy characterizes hæmatemesis and melæna, when present they are valuable diagnostic signs, but their absence does not necessarily indicate the absence of perforation of a viscus

Nor is the site of the wound an unfailing indication as to the involvement or otherwise of the abdominal cavity. A foreign body may enter almost any region of the body and traverse or lodge in the abdomen. The records of the present war injuries of the abdomen contain a surprisingly large percentage of cases in which a bullet entering the buttock has caused lesions of the cæcum or the pelvic colon, or where involvement of the kidneys, colon, liver and spleen has resulted from a foreign body entering behind a line extending from the mid-axilla to the anterior superior spinous process of the ilium.

A valuable diagnostic point is the consideration of the entrance and the exit wounds, where both are present, and the course and direction of the track, that is to say, the plane of abdominal involvement and the structures that may have been traversed. Intestinal injury, for example, may be taken practically for granted where the track of the bullet extends anteroposteriorly in the centre of the abdomen or where its course is transverse between the costal arch and the crests of the ilia. This type of injury is generally fatal, although a few exceptional recoveries have been reported. Intestinal injury likewise practically always results from contused wounds caused by localized violence, such as a sudden blow full on the abdomen or a fall from a height, or a weight falling on the abdomen

Abdominal injuries, I repeat, are to all intents and purposes emergency cases and there is little time for elaborate preparation before the patient

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reaches the operating table. The removal of the clothing, emptying of the bladder, washing the skin, preferably with a carbolic lotion or iodine, is about all that can be done in the majority of instances. Morphia and atropine are given hypodermically, and if possible one hour before the anæsthetic, preferably ether, is administered. Satisfactory results have been obtained with intravenous injections of bicarbonate of soda, just before the anæsthetic is given. The bicarbonate of soda not only counteracts the acidosis which is nearly always present, but at the same time reduces the concentration and the viscosity of the blood.

The incision is a matter of judgment on the part of the surgeon and will also depend on the suspected viscera involved, irrespective of the site of the wound. As a rule, however, a median or paramedian longitudinal incision is selected and should be ample so as to allow free access to the cavity, which in turn means rapid work. The value of X-ray demonstration of the location of the foreign body is well illustrated in those cases with only a single wound of entrance. It avoids unnecessary exploration of the entire abdomen, when a bullet has, for example, lodged in the loin, the only injury being a lesion of the colon to its peritoneal reflection, in which case the incision is made accordingly

Opinions differ as to the value of drainage to the pelvis and the flanks Some surgeons find nothing to recommend it, and they limit drainage to the use of a small drain carried down to the line of the sutured bowel, and thus provide a local track in case of leakage. Other surgeons drain in case of profuse hemorrhage where all oozing cannot be arrested, the best use of the tube in these instances being as a conductor for a tampon, also for possible leakage in wounds of the hollow viscera and when septic material has been extravasated and in cases requiring tamponage and temporary suture, also in stomach and colon lesions where there was much free blood in belly, or where, as often occurs in late cases, a free serious effusion had collected in the abdomen. It should be remembered that the peritoneum does its best work when unhampered, which means limited drainage, if any Lavage of the abdominal cavity is not generally advocated. Ether has

Lavage of the abdominal cavity is not generally advocated. Ether has been almost altogether abandoned for this purpose, satisfactory results with the use of warm serum have been reported but saline is the medium of choice. Personally I do not practice lavage, as a rule

As to the involvement of one or the other viscus, it appears that in war injuries of the abdomen the small intestine is the most frequently injured. The mucous membrane from the one or several perforations prolapses through the rent in the form of rosettes, the eversion being due to contraction of the longitudinal coat. The damage is local, the mucous membrane being normal up to the rent. It is the multiplicity rather than the danger of sepsis that lends these wounds their serious character. Suture is the proper method of treating them, resection being reserved for cases with numerous perforations close together. Post-mortem observation thus far has shown no evidence of spontaneous healing of wounds of the small intestines.

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The large intestine when wounded usually presents only a single tear or perforation rather than a complete section of the gut. The wounds of this viscus show a greater tendency to sepsis and sloughing than those of the small intestines. They are often extra-peritoneal, a notable feature being the extent of bruised surface, as seen in the collection of blood between the peritoneal and the external walls

Colon wounds are characterized by their tendency to localization Therefore if they come to operation later than twenty-four hours after injury it is advisable to enlarge the original wound with the idea that infection is localizing. If seen before that time a separate incision is the better procedure. Colotomy at the site of injury is required when the wound is extensive, otherwise suture reinforced by omental graft seems to be the chosen method. Suture combined with proximal colotomy has not found the extensive application that was expected. It proved to be superfluous, masmuch as, the tissues being already infected, its primary object of limiting infection had already been forestalled, besides which the extra opening in the bowel is undesirable.

Wounds of the stomach are usually associated with injury to other abdominal viscera and often with lesions of the thorax. Peritonitis following a stomach wound usually develops slowly and runs a subacute course, except where bile has escaped from the stomach. Simultaneous perforation of the anterior and posterior wall often takes place, and as the latter is easily overlooked, careful exploration of the entire stomach through the intercolo-epiploic route is most important. It seems that suture is the preferred method of dealing with perforating gunshot wounds of the stomach Gastro-enterostomy, with or without previous suture, is resorted to only for very extensive lesions or when the antrum or the duodenum is involved or where there is a narrowing of the stomach

Wounds of the rectum, when extraperitoneal, are treated in the usual manner by establishing drainage after the wound has been opened up, and when intraperitoneal, by suture followed in certain cases by colotomy. If possible the colotomy is made in the transverse colon, this opening being more easily controlled and cleansed facilitates subsequent restoration and closing of the bowel. Also in the event of secondary operation for the repair of the rectum the pelvic colon can be mobilized and brought down to the injured part.

Bladder wounds are fortunately rare, for their mortality is very high Extraperitoneal injury, indicated usually by hemorrhage into the bladder, may be treated by catheterization or by perineal section, intraperitoneal injury, however, the more serious of the two, demands immediate operation

Of the solid viscera the liver is the most frequently involved, and is at the same time the viscus which most often recovers without operation Operation is indicated where there is evidence of profuse hemorrhage, and generally consists of inspection, plugging and drainage

Wounds of the spleen per se usually require splenectomy They gener-

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ally occur as complications of other lesions. This is also true in the rare instances of wounds of the pancreas. The prognosis of pancreatic injury is bad, hemorrhage is generally very severe, and treatment is mainly directed to controlling hemorrhage by suture or gauze packing and lumbar incision

Post-operative treatment of the traumatic abdomen does not essentially differ from the regimen in use for other abdominal operations. In fact, this necessarily rapid and cursory survey seems to bear out the statement that there is little difference in civil and war surgery of the traumatic abdomen. The great advantage gained from war experiences is the removal of any hesitancy in exploring the abdomen, and with it the reduction of about ten per cent in the mortality in this type of injury. This alone justifies the prevalent practice of early and thorough exploration and operation, although, if carried to its logical conclusion, it represents a certain risk of losing some cases that might have recovered without operation

# ACUTE PANCREATITIS\*

By John B Deaver, M D. of Philadelphia, Pa

In the presence of an acute abdominal crisis the practitioner is likely to forget about a certain elongated gland situated in a deep recess behind the stomach as the probable cause of the sudden and dramatic syndrome he is called in to treat. It is because of the importance of this organ in upper abdominal disease that I venture once more to discuss the subject of acute pancreatitis

It is, perhaps, no exaggeration to say that the condition is more often unrecognized than it is diagnosed before operation There are a number of reasons why this is so In the first place it is comparatively infrequent, but nevertheless more frequent than is generally supposed, and, as in other abdominal conditions, there is no one sign or symptom that can be said to be pathognomonic of the disorder, and most often the desperate condition of the patient makes operation imperative without the formality of a definite The latter, of course, applies particularly to the ultra-acute It is in the less acute cases diagnosis is important, as we shall pres-Another fact that interferes with a positive diagnosis is that acute pancreatitis is so frequently associated with other severe abdominal lesions, such as cholecystitis, perforating cholecystitis, perforating gastric or duodenal ulcer, appendicitis, etc. In fact, it is often mistaken for one or the other of these conditions, most cases, however, come to operation with a diagnosis of acute intestinal obstruction Differentiation is usually possible only after a careful examination and a carefully taken history, and then only if the case is seen early, that is, several hours, or at most a day or two after onset. The confusion is also in some measure due to the fact that pain, without doubt the most conspicuous and persistent symptom, in acute pancreatitis may arise in various parts of the abdomen, although, as a rule, it originates deep in the epigastrium rather to the left, later radiating to the back, and is at once severe and overwhelming. It is, if possible, more agonizing than the pain of perforating viscus Shock in the ultra-acute case may be so extreme that death ensues in a few hours Shock is more prolonged in severe cases of acute pancreatitis than in ruptured viscera character of the pain differs from that of acute intestinal obstruction masmuch as in the latter the onset is less severe and is at first intermittent, growing progressively worse in the course of a few hours I may, however, remark that in the acute obstruction due to strangulated internal hernia and twists, the pain is intense and at first referred to the site of the initial pathology With regard to the localization of the pain in acute pancreatitis,

<sup>\*</sup>Read before the Philadelphia Academy of Surgery, April 4, 1918

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Desjardin has suggested a pointe pancreatique over the outlet of the duct of Wirsung, 5-7 cm above a line connecting the umbilicus with the right axillary cavity, as of diagnostic value, but this has not been found a constant The Mayo-Robson's point, about 10 cm above the umbilicus, 15 Sometimes the pain localizes in the region of the more characteristic appendix, and is then probably due to a distention of the inflamed peritoneum, as the result of the diffusion of the exudate in the region of the cæcum, such as often takes place in perforating gastric or duodenal ulcer Or again, as the result of the inflammatory process and the action of the pancreatic juice, there is necrosis and sloughing of the tissues which find their way into the ileocæcal region and give rise to a tumor mass suggestive of appendicitis, as in the case reported by de Groot and also one in my experience Operation in de Groot's case revealed a normal appendix, the abdominal cavity was filled with blood-stained exudate, and there was no trace of blood in the pancreas Typical fat necrosis was found in the ascending colon and in the preperitoneal fat A large stone was present in the gall-bladder There had been a history of several attacks of severe epigastric pain radiating to the right, and a diagnosis of acute appendicitis had been made

In my case the patient came to the hospital for the relief of a biliary fistula which had formed after a cholecystostomy (done elsewhere) one year previously. There was tenderness and marked rigidity in the region of the right iliac fossa. At operation the appendix was found to be normal. Operation consisted of cholecystectomy and appendectomy. The pancreas was enlarged throughout, especially its head. After operation bile continued to drain for several days, followed by a discharge of pus. The tenderness in the right iliac fossa persisted. A second operation four weeks later revealed an abscess, material from which contained fat necrosis. The patient died on the sixteenth day. At autopsy the pancreas was found completely necrosed.

Vomiting is a constant feature of acute pancreatitis and is frequent and persistent for at least twenty-four hours, when it may subside somewhat, except in the late stage, it is not fecal. Nausea and retching may continue, hiccough is a frequent symptom and is persistent and oft-repeated.

The accompanying constipation is not always complete. In this it differs from intestinal obstruction. Flatus is sometimes spontaneous or can be obtained, and stool, also, by enema

There is absence of marked rigidity, which, on the other hand, is the most pronounced physical feature in ruptured viscera. Tenderness in the left costovertebral angle is of extreme importance from a diagnostic point of view, indicating, as it does, involvement of the central portion or body, and more especially the tail of the pancreas. Distention is not so marked as in other abdominal crises, and is limited at first to the upper portion of the abdomen, in fact, the small intestine has in some instances been found collapsed.

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The pulse is usually quiet and slow at first, and gradually increases Subnormal temperature accompanies the initial collapse, but rises moderately later on The temperature range is low compared to that of a spieading peritonitis

Cyanosis is often seen and appears as, what is considered by some, a characteristic dull yellow hue

There is leucocytosis, and the polynuclear count is increased

As to predisposing factors, obesity and alcoholism are sometimes mentioned. Age and sex do not seem to play a part in this respect, as the disease has been observed in young persons of both sexes as well as middle-aged and older ones. In the series of fifteen cases operated at the Lankenau Hospital, since 1913, the ages ranged from twenty-four to fifty-four. Some authorities, notably Korte, claim a preponderance of males in the proportion of two to one. This has not been my experience. In the above 15 cases there were 11 females. Linder reports 76 per cent.

We may therefore say that a sudden acute abdominal seizure, pain overwhelming, in an apparently healthy, usually obese, individual, accompanied by incessant vomiting, upper abdominal distention, a transverse resistance not easily elicited, weak pulse, subnormal temperature, collapse, and sometimes cyanosis, should suggest acute pancreatitis. The previous history will usually reveal one or more, usually more, attacks of severe epigastric pain which have been regarded as gall-stone colic and have been treated as such. Not infrequently the first attack of this kind occurs during or soon after a pregnancy. That it may be due to a pancreatic lesion is well illustrated in Case II, cited below. Watts² reports 7 cases of acute pancreatitis, 2 of which occurred four and seven weeks respectively after a pregnancy.

There is, indeed, little doubt that in a large number of cases of gallstone disease the pancreas has been involved, and it is because of this fact and because of the unfavorable prognosis presented by acute pancreatitis as such that I so strongly and continuously advocate early surgery for gall-stone disease, as well as for other chronic abdominal conditions is a well-established fact that the gall-bladder is the upper abdominal organ most frequently affected by infection Owing to the anastomosing network of lymphatics in the retroperitoneal tissue which connects the gall-bladder and the pancreas, it is but natural that secondary infection of the pancreas may occur by this route In like manner, not a few cases of gastric and duodenal ulcer and also colitis have come to be associated with disease of the Here again the path of infection can be traced through the lymphatics leading from the colon through the transverse mesocolon to the My experience with small circumscribed abscess of the pancreas in perforating appendicitis and, in another instance, of pancreatic abscess

Jour Amer Med Assoc, 1917, 1x1x

<sup>&</sup>lt;sup>2</sup>Ann Surg, 1917, Ixvii, 293

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and retroperitoneal diffusion of pus from infection of the left lower extremity would also seem to indicate the possibility of retroperitoneal infection of the pancreas from a distant focus by way of the ascending lymph channels

Acute pancreatitis is essentially a surgical disease, and the importance of making a diagnosis in the less severely acute cases thus becomes apparent For merely the relief of tension afforded by operation in these cases not only favorably affects the circulation, but in providing an outlet for the exudates inhibits the local destructive toxic process. The extensive study to which the pancreas and its secretion have been subjected during the past decade have taught us to regard with increasing respect and alarm the inherent noxious action of the powerful ferments of the pancreatic juice The typical areas of fat necrosis, which furnish the most striking and reliable diagnostic sign to the surgeon, we now know to be due to the lipolytic action of lipase together with the trypsin of the pancreatic juice As I have elsewhere pointed out,8 the rôle of the proteolytic ferment, trypsin, in connection with acute pancreatitis has only recently been recognized It is but natural that any inflammation which causes a diffusion of lipase must also carry with it the other ferments of the pancreatic secretion Trypsin as a factor in this process has been overlooked because its action is not so greatly evident as is the fat necrosis due to the lipase, although it is possible that hemorrhage, so often noted in acute pancreatitis, may be traced to the digestive action of the trypsin on the vessel walls

Trypsin is known to be one of the most powerful ferments elaborated within the body. In weakly alkaline solution it exerts a powerful action in splitting proteins into their lower constituent molecules. While in the intestinal canal this action is part of normal digestion and the end products are made available for absorption and for metabolism, when directed against the tissues this powerful agent is capable of doing much harm. In other words, trypsin is normally secreted in the pancreas as protrypsin and requires the activation of the so-called enterokinase of the duodenum to convert its latency into active energy. This is one of the reasons why normally the pancreas itself escapes self-destruction. But in the presence of abnormal conditions, trypsin is activated within the pancreas, its digestive and destructive action is readily seen on the tissue cells and vessel walls of the pancreas and surrounding structures, injury of which permits the escape of blood, with acute hemorrhagic pancreatitis as the result

The destructive action of trypsin may by inference and demonstration be further seen in the toxemia of acute intestinal obstruction, which has been shown (in experimental work) to contain a powerful toxin that proves fatal in exceedingly small doses <sup>4</sup> This substance complies with the essential characteristics of a proteose, one of the earliest decomposition products of protein when acted on by trypsin Furthermore, the resemblance of the

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Whipple, Stone and Bernheim Jour Exper Med, 1914, xix, 166

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toxæmia of acute pancreatitis to that of intestinal obstruction has been remarked by Sweet <sup>5</sup> It is not at all unlikely that the toxæmia of the two conditions is either identical or closely related, and is due to the toxic derivatives of the proteolytic action of trypsin. The practical value of these theories, if true, is self-evident

The surgery of the pancreas must be directed to providing an escape for the highly toxic pancreatic fluid which has become activated as the result of infection or of trauma, or as the result of a chemically induced inflammation by the irritating action of the dammed back bile words, the pancreas must be drained We are not yet prepared to resect the pancreas, although experimental work, notably that of Sweet, has shown that at least two-thirds of the gland can be removed with a reasonable degree of safety, the only difficulty being one of technic For the present, however, especially in the ultra-acute cases, we can do no more than by rapid section and drainage hope to save the life of the patient. But outside of these desperate cases the question arises whether to confine the work to the pancreas or to deal with associated lesions In the severe cases I have no hesitancy in stating emphatically that our energies should be confined to the pancreatic lesion Operation on the bile tract plays little if any rôle in these cases, and the time consumed only adds to the risk recent series of fifteen cases (operated since 1913), draining the pancreas was the only procedure in three, all of whom recovered; in three others a cholecystostomy with drainage of the pancreas, two recovered and one died, in this fatal case the question arises—had operation upon the pancreas alone been done would recovery not have occurred? One case of pancreatostomy and cholecystectomy ended fatally This is the case already referred to In the remaining eight cases nothing was done to the pancreas, drainage of the gall-bladder in six gave five recoveries, and drainage of the common duct together with removal of the gall-bladder in two resulted in one recovery and one death

The mortality in the series (4 deaths) equals 266 per cent, an encouraging improvement on the figures of a previous series of 22 cases which represented a mortality of 54 per cent (Deaver and Ashhurst Surgery of the Upper Abdomen, vol 11, p 303, Philadelphia, 1914)

As to the time of operation In the fulminating case the rapid progress from bad to worse may make immediate intervention necessary. I am not always in favor of operating in a state of profound shock. I cannot agree with Sweet who favors operating in profound shock, using saline and adrenalin infusions before, during and, if necessary, after operation. In certain cases I deem it wise to wait for a short time in order to give the patient a chance to rally and to wait for the peritoneal inflammation to localize. This, however, is a matter of judgment acquired only by extended experience. In the interim, the Murphy-Fowler-Ochsner method of treat-

<sup>&</sup>lt;sup>5</sup>Sweet Surgery of the Pancreas, 1916, Philadelphia

ment is instituted Severe shock may be combated by the administration of morphine, infusions of salt solution, or adrenalin and pituitrin, and thus the patient's condition brought as speedily as possible to a point where operation may be undertaken with a reasonable expectancy of a favorable outcome Early operation is desirable, especially in the hope of preventing the extravasation of blood and ferments into the pancreas and the surrounding tissues Since the pancreas is not provided with a capsule, the extravasated material readily finds its way into the surrounding parts The presence of blood and fluid exudate in the pancreas requires incision and packing with gauze The question of the extent of incision or scarification and puncture of the pancreas cannot be stated in any hard and fast rules, our experience being still somewhat limited Too free and indiscriminate an incision presents the danger of free hemorrhage, difficult to control Sacrification of the peritoneum over the gland should, however, be sufficient to allow gauze drainage to be brought into direct contact with the surface, this also opens up the retroperitoneal space and aids in preventing accumulation about the pancreas A few blunt punctures of the pancreas are of service in providing free exit for the contained blood, lymph, and the obstructed secretion

In operating on the pancreas we may choose one of two routes—the transperitoneal or the extraperitoneal through a loin incision. The latter allows approach to the pancreas, especially its tail, without entering the peritoneal cavity. While this may be of advantage it does not permit free exposure of the parts, so that radical surgery, should it be indicated, is not possible. It is, in fact, feasible only where the symptoms point to the localization of the inflammatory exudate or to the presence of pus in the loin.

The transperitoneal route is in order in a beginning pancreatitis when the localizing symptoms are all epigastric, when there is a palpable tumor or when the diagnosis is in doubt. This doubt is often cleared up by the presence of fat necrosis and typical odorless beef broth fluid in the peritoneal Once in the general peritoneal cavity the pancreas itself can be reached either through the gastrocolic omentum, through the lesser omentum, or through the transverse mesocolon While presenting the disadvantage of the risk of infecting the general peritoneal cavity, the advantages of this approach are seen in the free exposure of the operative field, the opportunity for radical surgery, should this be desirable, and for establishing adequate drainage, a most important item whether the disease is in a suppurative or in a hemorrhagic state In acute hemorrhagic pancreatitis, having approached the organ through the transperitoneal route, the only possible procedure is to apply tampons and drains freely to the organ itself, going either above or below the stomach according to circumstances tubes and gauze dramage should be used and should be conducted to the surface through an enveloping sheet of rubber dam to lessen the chance of adhesions to the stomach and intestines Any free fluid in the peritoneal cavity should, of course, be removed by gentle wiping, for this pancreatic

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exudate itself contains sufficient toxic material to cause death. Drainage of the pelvic cavity is also indicated in these cases

One of the most troublesome postoperative effects of drainage in acute pancieatitis is the formation of sinuses. The effect of the pancreatic ferments on the tissues can be noted in the intense irritation of the skin over which the discharge flows and in the sluggish formation of granulations continuously subjected to the severe erosive action of the pancreatic juice. The skin should, for this reason, always be protected by a bland ointment to prevent contact with the secretions, for after excoriation has once taken place it is practically impossible to get anything to stick to the moist surface. In order to limit the activity of the pancreas a strict antidiabetic diet, as suggested by Wohlgemuth, is advisable, and is found useful in promoting healing

In conclusion, permit me to give two recent histories which will serve to illustrate some of the points contained in this discussion

Case I — Female, fifty-four years old, married, admitted July 10, 1917, with a history of repeated attacks of severe abdominal pain requiring morphia for relief. The pain was generalized over the whole abdomen, but was most pronounced over both hypochondriac regions, extending to the back. Persistent vomiting accompanied the attacks Never jaundiced. Had one such attack three weeks ago, and another the day before admission. Vomiting in the latter had ceased for several hours, but nausea persisted. Bowels moved day before admission. No cardiac, respiratory or nervous symptoms.

Past medical and social history otherwise negative

Physical Examination — Obese, middle-aged woman No jaundice or adenopathy Teeth fair Throat congested, left tonsil inflamed and swollen, no exudate Chest negative Heart regular, slow, poor tonus Blood-pressure 120–80

Abdomen Slight general distention, tenderness marked in upper abdomen equally on both sides, with rigidity partly voluntary. No masses palpable. Peristalsis subnormal. Temperature on admission 98°, pulse 56, respiration 24

Tentative diagnosis, gall-bladder disease

Operation (July 11, 1917) —Upper right rectus incision Small amount of turbid fluid present in the peritoneal cavity, infiltrating the great omentum. Stomach found distended and pushed forward A rent was made in the gastrocolic omentum, opening up the lesser peritoneal cavity, from which a turbid fluid escaped. The pancreas was found to be ruptured. One piece of gauze was packed into the pancreatic substance. A sheet of rubber dam was placed down to the pancreas and one piece of gauze within it. Another piece of gauze was packed outside the rubber dam. The gall-bladder was opened and a cholecystostomy performed. Wound closed to drainage. Dry dressing.

The patient had a prolonged convalescence with septic tempera-

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ture for some time Was discharged, August 29, 1917, with a clean granulating wound almost closed

Case II—Woman, aged twenty-four, married Admitted February 16, 1917, with severe pain and abdominal distention. Onset of pain four days ago. Began in left chest and later in epigastrium, radiating around both costal margins to both shoulders, and then spreading over entire abdomen which became very much distended Persistent vomiting of bitter greenish material. Unable to retain any food. Bowels moved by purgative, distention subsided somewhat Has a slight cold but no pain in chest on deep respiration.

Previous history negative Never had a similar attack Has a child three weeks old

Physical Evanination —Well-nourished, rather stout young woman Lips parched Tongue partly coated and peeling Teeth poor Breath foul Chest respirations rapid Expansion shallow Breath sounds harsh Heart negative

Abdomen General abdominal distention Voluntary rigidity, unable to make satisfactory examination Temperature 98°, pulse 84, respiration 28

Operation (February 19, 1917) —Peritoneum opened Omentum protruded showing multiple areas of fat necrosis Gall-bladder distended with stones and gall-bladder chronically inflamed Omentum adherent around gall-bladder Lesser peritoneal cavity opened through the gastrocolic omentum Small cavity in the pancreas found filled with blood Extensive fat necrosis present Four pieces of gauze were packed in the cavity of the pancreas through the opening in the gastrocolic omentum. One cigarette drain was placed down to the pancreas. One piece of rubber dam was placed alongside of cigarette drain and two pieces of gauze superficially around the other drainage. Abdomen closed to drain. Dry dressing

The patient made a good operative recovery, but continued to drain freely for several weeks Convalescence interrupted by left pneumonia and acute tonsillitis Finally a good recovery, and was discharged May 6, 1917

# THE INCIDENCE OF CALCULI IN THE GALL-BLADDER AS MET WITH IN 1600 NECROPSIES

# By Louis J Mitchell, M D OF CHICAGO, ILL

WHILE Naunyn points out that accurate statistics of the occurrence of gall-stones can only be based on data obtained post mortem, objection is often made to the usual necropsy statistics in that such examinations are generally carried out in elderly subjects, of ages at which cholelithiasis is to be expected Also, that they are largely from hospitals frequented mainly by the working classes, in whom gall-stones are not so frequent as in the well-to-do For this reason it is thought the following notes on the incidence in 1600 subjects of all ages will be of value. They are derived from a service as Coroner's Physician many years ago, and, as a rule, from individuals dying suddenly either from violence or disease, and not in hospitals or almshouses

In the 1600 necropsies, calculi were found in 50 cadavers, or 31 per cent (In addition, on one occasion, a stone was found in the common duct with the gall-bladder obliterated, and on another, one in the cystic duct) This percentage is higher than in some similar collections, approximately the same as in others, and decidedly lower than in still others the gall-bladder was opened in every instance, so there was no possibility of any concretion being overlooked

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Λı	ECROPSIES
7.7	<b>ECKOLDIES</b>

	Total No	With Calculi	Per cent
Erlangen and Munich (Ritter)	19,974	1,652	78
Petrograd, Obouchow Hospital (Hesse)	17,402	378	2 17
Basle (Roth-Courvoisier)	16,025	1,714	107
London, Guy's Hospital (Ticehurst)	11,133	335	3
Copenhagen (Poulsen)	9,172	347	38
Japan (Miyake)	8,406	257	3 05
Kiel (Peters)	5,962	161	27
London, St George's Hospital (Rolleston)	4,616	268	58
Calcutta (Rogers)	4,544	233	5 37
Dresden (Fiedler)	4,300	270	63
London, London Hospital (Walton)	3,755	131	3 48
Sweden (Scheel)	2,753	406	15
New York, Presbyterian Hospital (Herter), g	all-		
bladder only	2,371	179	76
Gottingen (Hunerhoff)	1,951	85	44
Albany, Bender Laboratory (Stanton)	1,667	120	72
Baltimore, Johns Hopkins Hospital (Mosher)	1,655	115	6 94
Unicago (Mitchell), gall-bladder only	1,600	50	3 1
Manchester (Brockbank)	1,347	101	74
19			

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#### NECROPSIES

	Total No	With Calculi	Per cent
Strasburg (Schroeder)	1,150	141	I 2
Panama (Clark), negroes	1,088	24	22
Tomsk, Pathologic Institute (Hesse)	1,000	31	3 1
Panama (Clark), whites and half-breeds	404	12	3
Toronto (Ryerson)	333	12	4
Operations			
London Hospital (Walton), 10 years	76,410	409	o 53
Mayo Clinic, uterine myomata (Mayo)	1,244	92	71
Ann Arbor, laparotomies (Peterson)	1,066	135	126
Laparotomies (Truesdale)	500	34	6+

Sex—In this series there were 1315 males and 285 females, and the number with calculi was 28 (21 per cent) and 22 (27 per cent) respectively

Other series give the proportion of the sexes as follows

	Total Necropsies	Per cent Males	Per cent Females
Petrograd	17,412	0 73	4 75
Basle	16,025	59	155
Japan	8,406	25	3 98
London	4,616	25	32
Calcutta	4,544	4 05	8 r
Dresden	4,300	39	96
Sweden		(sexes equal)	
New York	2,371	24	42
Manchester	1,667	4	15
Baltimore	1,655	5 49	9 37
Chicago	1,600	2 I	72
Strasburg	1,150	4 4	20 6

Age -The distribution by ages is shown in the next table

		Mai	.ES			FEMALES	
	Whites	Negroes	Chinese	With Calculi	Whites	Negroes	With
Up to 20	113	10		2	41	3	Calculi
2I to 30	274	32		2	68	14	3
31 to 40	326	21	5	3	62	11	7
41 to 50	301	18		4	42	5	4
51 to 60	131	3		4	18	2	3
б1 to 70	71	1		13	13	2	2
71 to 80	6			1	3		2
Over 80	3			I	I		-
		_	~			_	
	1,225	85	5	28	248	37	22
Youngest subject	with calci	ılı—25			Younges		20
	Olde	st84				Oldest	

Courvoisier also found the maximum from 60 to 70, and 22 2 per cent of Rogers' cases were over 60

#### CALCULI IN THE GALL-BLADDER

This may be compared with the age-incidence in 1071 cases (Hubbard, Lichty, and 4 other authors)

Under 20	7
21 to 30	80
31 to 40	207
41 to 50	274
51 to 60	258
61 to 70	245
	<del></del>
Total	1,071

Color—No calculi were met with in the 5 bodies of Chinese males, nor in the 85 male negroes, these latter included 2 Beninese from the west coast of Africa. Of the 37 female negroes, gall-stones were found in two, aged thirty-one and forty-two respectively

Mosher states at Johns Hopkins, gall-stones were present in 785 per cent of the whites and 551 per cent of the negroes. Clark, from experience in the Canal Zone, concludes the West Indian negro is more liable to calculi than the same race in temperate climates. In fifteen years Rodman never saw a case in Louisville, Ky, and only one in ten years at Philadelphia Though he adds that a few were reported to him from the Pennsylvania Hospital, located near a large negro colony

There seems to be but little on record as to the prevalence of biliary concretions in tropical climates. Hirsch asserts they are "decidedly less common than in higher latitudes." On the other hand, Castellani and Chalmers state they are "often met with," which they attribute to typhoid fever, though they may also arise from other causes. At Calcutta, Rogers believes biliary calculi are actually more common than in some European climates. Mohammedans are slightly less liable than Hindus, and Europeans considerably more so

According to Robson and Cammidge, Morehead during many years' practice in India saw only 4 cases Rufz did not meet with a single case in Martinique, and the same experience is reported by Borchgrevink from Madagascar Pruner Bey states that in Egypt they are rather more common in Europeans and Turks than in natives and negroes, and Hartmann speaks of them as being very unusual in any class Elliot Smith has recorded an example of gall-stone in a mummy of the New Empire

As regards China, while urinary calculi are excessively abundant, Jefferys and Maxwell record but a single case (Shanghai) though they received reports from practically all parts of the country. They observe that Middle China, about Canton,  $e\,g$ , escapes

Number of Calculi—In 13 instances single stones were found, in 37 more than one, from 2 or 3 up to 632

Association with Carcinoma—Scheel found cancer of the gall-bladder in 5 of his 406 cases, and Hesse in 15 of his 378 cases In 5 more, though

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cancer was present, there were no gall-stones Malignant disease was met with in 44 per cent of the 1164 cases in Courvoisier's series. None of the gall-bladders in the present series showed any gross changes resembling cancer. This statement, of course, is of limited value, since the time concretions were present is not known.

In this connection the cause of death as established at the post-mortem examination is of interest

	With Gall Stones	Total Necrop <ies< th=""></ies<>
Valvular heart disease (aortic, 9, mitral, 2)	11	58
Fatty degeneration, and other forms of myocardial disease	5	95
Pneumonia ,	8	95
Pulmonary tuberculosis	3	67
Chronic pleuritis	I	18
Cirrhosis of liver	1	6
Nephritis	2	39
Apoplexy	3	23
Alcoholism	3	141
Senility	I	2
Abortion	4	
Murder	2	
Suicide	3	
Accident	3	

In no instance was the cholelithiasis the direct cause of death

Association with Valvular Disease of the Heart—Brockbank in his experience at Manchester in 1347 necropsies found biliary calculi in 54 per cent of the cases without cardiac disease, and 109 per cent of those with such disease, and more with the mitral variety (His figures are derived from the Infirmary) In this series there is practically no difference between mitral and aortic disease

	With Gall Stones	Total Necropsies
Aortic disease	42	9
Mitral disease	II	2
Combined aortic and mitral disease	5	o

Rolleston found the percentage of gall-stones was "a little higher" in aortic than in mitral disease

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# KIDNEY-URETER ABNORMALITIES

# BY THOMAS N HEPBURN, A M, MD, FACS of Hartford, Conn

Congenital abnormalities of the kidney and ureter are now known to be very common, and, with the improved methods of diagnosis, they can generally be recognized before operation. In reporting cases of abnormalities it is regrettable that some of the reports in the literature are not as full as might be wished, masmuch as it is difficult to tell whether the diagnoses were made before operation, at operation, or at autopsy, and we are told little of the post-operative history in some cases

The first case I wish to report is one of fused uneters I find, in a cursory review of the literature, only one like it reported That case was reported by Braasch in Annals of Surgery, vol Ivi, p 726

Case I —October 16, 1916 Female, aged thirty-one years, married, housewife, American On personal ward service at the Haitford Hospital Her family history was negative. Her past history was negative except for a severe attack of mitral insufficiency with broken compensation six years ago. She has had eight full-term pregnancies. Her present illness dates back four years, when pain in her right renal region began. This pain has continued off and on since, and two days ago became severe. Then for the first time she sent for a physician, who sent her to the Hartford Hospital. No dysuria

Examination -A well-nourished, vigorous-looking woman, evidently in pain and acutely ill Her heart showed mitral insufficiency with compensation In the region of the right kidney was a large tender tumor The urine was very full of pus Her temperature was 1038 and her leucocytes were 24,200 (88-12) X-ray examination showed no shadow other than the indefinite outline of a large kidney Cystoscopy showed a bladder wall almost normal. There were practically no signs of cystitis The right ureteral os was slightly dilated, and ejaculations of very pussy urine could be seen easily. I attempted unsuccessfully to catheterize it, the catheter being stopped 3 cm up The left ureteral os could not be found after a thorough search Realizing that it was essential to establish the presence of a normally functioning left kidney before removing the pyonephrotic right one, I injected intravenously 20 c c of a 4 per cent solution of indigo carmine as an aid to locating the os of the left ureter To my surprise it appeared promptly and in dense clear blue spurts from the right os Then could be definitely seen alternating the ejaculations of dense pussy urine and the brilliant purple urine from the single right os

Diagnosis—Right pyonephrosis Normal left kidney Right and left ureters fused I did not attempt to establish the point of fusion by the injection of thorium or any other fluid for a pyelogram, as

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Braasch did in his case, because I feared forcing some of the infected urine up into the good kidney The patient was in a very bad condition and required quick relief, rendering imperative early removal of the right kidney

First Operation (October 17, 1916) —Under ether anæsthesia the right kidney was exposed and found to be so greatly infected that nephrectomy was desirable. My assistant was very dubious about the presence of a left kidney, so before starting the right nephrectomy, the left loin was opened and the presence of a normal left kidney demonstrated. The large pyonephrotic right kidney was then quickly removed. The ureter was carefully dissected down for 3 inches so as not to ligate below its fusion with the left side and tied with No 2 chromic catgut.

Post-operative History—She made a very quick recovery, but the wound continued to drain pus, and after one month urinary drainage began. This continued in spite of the improvement in her general con-

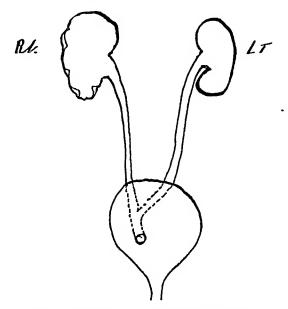


Fig i -Diagram of a case of fused ureters

dition I had her return to the hospital and again cystoscoped her Chromoscopy with indigo carmine revealed the same dense ejaculations of purple urine from the single ureteral os on the right side. It also appeared in the urine from the right lumbar wound. As there was still pus from the right ureter I made no attempt at pyelography to establish the point of fusion. This question it seemed to me safer to establish by an extensive open dissection along the course of the old right ureter before resecting it

Second Operation —A long incision was made along the right border of the abdomen and the right ureter was exposed retroperitoneally from its renal end well down into the pelvis, but no sign of the fusion could be found. The incision was such that I could not see well at the bladder end, and I feared injuring any tissue that might contain the left ureter. Therefore I made a midline suprapubic incision, and peeled the peritoneum off the bladder, thus exposing the bladder end of the ureter more easily. The fusion with the left ureter was then found

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just outside of the bladder wall as shown in the diagram (Fig I) The right ureter was ligated close to the fusion and the wounds closed The woman made a quick recovery, leaving the hospital in two weeks She has had no urinary difficulty since, although she has been in the hospital recently with a recurrence of her heart trouble

The second case I wish to place on record is one of bilateral duplication of kidneys, pelves and uneters

CASE II —Mrs Mary W, aged forty-five years, entered the Hartford Hospital February 23, 1918 Her family history and past history revealed nothing of note

Present illness dates back "many years," as pain in her right side, which her various doctors called liver trouble, in spite of urinary frequency and dysuria of four years' duration. The pain has been getting worse lately, and beginning one month ago she began to notice a swelling in her right hypochondrium. The doctor sending her into the hospital took the tumor to be a gall-bladder

Examination —Shows a rather thin woman with an easily palpable tumor in the upper right abdominal quadrant which extends back over the right renal fossa, and anteriorly one inch beyond the midline. The urine is loaded with pus. The temperature and leucocytes show moderate elevation. X-ray shows no shadow other than the indefinite outline of a large right abdominal tumor. Cystoscopy shows a mild general chronic cystitis.

On the right side there are two ureteral openings 2 cm apart, one above the other. From the lower opening pussy urine can be seen to come. A No 6 F ureteral leaded catheter was easily admitted 20 cm up each of the right ureters, and the cystoscope was withdrawn and threaded with two more catheters. Two uneteral openings were found on the left side, and were each catheterized with No 6 F leaded catheters. The catheters were marked right, upper and lower, left, upper and lower.

The right upper catheter drained freely a very pussy urine which was sent to the laboratory, where the pathologist found pus-cells and a thick growth of colon bacillus

The right lower catheter drained freely clear, normal looking urine which was collected in a sterile test-tube and sent to the laboratory, where the pathologist found it to be normal

The left upper catheter drained normal appearing urine which was pronounced negative in the laboratory

The left lower catheter drained normal urine, also pronounced negative in the laboratory Differential renal function was done by the injection intravenously of a 6 of a milligramme of phenolsulphone-phthalein which was excreted as follows From the right upper catheter not at all, right lower catheter in 6 minutes and in 15 minutes 5 per cent, left upper catheter in 6 minutes and in 15 minutes 5 per cent, left lower catheter in 6 minutes and in 15 minutes 5 per cent. There was no bladder leakage



Fig. 2 —X-ray of leaded catheters and 15 per cent, thorium injections showing bilateral duplication of kidneys pelves and ureters.



# KIDNEY-URETER ABNORMALITIES

Pyelography—Fifteen per cent thorium was inserted into each catheter by gravity and an X-ray picture taken which is shown in Fig 2. This demonstrated a duplication of ureters and pelves on each side. The picture on the right side is not so clear because of the large pyohydronephrotic upper kidney concealing the normal pelvic outline of the lower right kidney (see Fig. 2).

Diagnosis —Bilateral double kidneys, pelves and ureters, one of the

right kidneys being pyonephrotic

Operation (Dr George N Bell) (February 26, 1918) —Under ether anæsthesia the right kidneys were exposed and the large upper pole of the tumor so enveloped the lower normal kidney that it seemed dangerous to try to separate them Therefore, the pyonephrotic upper kidney was removed with the lower normal kidney en masse The wound was closed without drainage and the patient made a quick recovery

The pathological report by Dr Henry C Russ was as follows

Macroscopically the specimen showed a dark reddish-brown kidney 6½ cm long and normal in shape, with a ureter 3 mm in diameter. Above and separate from this is the dilated shell of anothr kidney with a ureter dilated to 10 mm in diameter. The calyces of this upper kidney are much dilated and communicate with a much-enlarged pelvis. The cortex is very thin, the pyramids having disappeared. There is a separate blood supply to each kidney

This case is the only one I can find with proven bilateral duplication of kidneys, pelves and ureters. Braasch, in the same article referred to above, shows a diagram of a case apparently almost complete, but there is a connection between the calyces on one side. There is no doubt but that the operation in the case here reported should ideally have been the removal of the infected right kidney alone, leaving the normal one—as Young, Mayo and others have done—but it seemed dangerous at the time to attempt it

# DIVERTICULA OF THE BLADDER\*

# By E S Judd, M D

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THE increasing frequency with which we have encountered diverticula of the bladder in the past few years has led me to review the cases that have been treated at the Mayo Clinic Presumably this condition does not occur more frequently now than formerly, though with a somewhat better understanding of the surgery of the bladder in general, and with the great advance in methods of examining all patients with bladder trouble, many more are being presented for surgical treatment

#### ETIOLOGY AND PATHOLOGY

The question as to whether or not these diverticula, as well as those occurring in other parts of the body, are congenital or acquired, has been widely discussed, and many convincing articles have been published supporting each contention. Undoubtedly diverticula of the bladder may be congenital, as instances have been reported in infants and small children, and it would certainly seem that in most of such cases there must have been some congenital defect in the bladder as a primary etiologic factor condition were always due to obstruction, it would probably occur more often in cases in which the stream of urine is obstructed. It has been suggested that the weak points in the wall of the bladder may be at the site of one of the embryonic buds While it seems possible that a diverticulum might occur at one of these points, and that this embryonic weakening might be the factor in certain cases, on the other hand, my observation leads me to believe that the point of dereliction is not constant enough to indicate that the majority originate from these buds In most of our cases the opening of the diverticulum was not far from one of the ureteral meatuses, but the relationship to the meatus was not at all constant, so that in some cases, the diverticulum opened into the bladder in front of the meatus of the ureter. in others, well above it or posterior to it, and in some cases in the base of the bladder posterior to the trigone. It is certain, however, that the greater number of the diverticula do have a proximity to the ureter The diverticulum that occurs in the dome is rarely seen, and apparently is an entirely different type than the diverticulum under discussion

The close relationship of the diverticulum to the ureter may mean that the diverticulum, especially if it is of considerable size, will interfere with the ureter. Several cases have been reported in which a hydronephrosis and a pyonephrosis have developed, apparently due to this interference with and pressure on the ureter. Cabot reports an interesting case in which bilateral

<sup>\*</sup> Read before the American Surgical Association, June 7, 1918

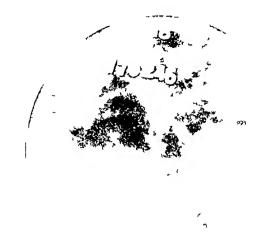


Fig. 1—(179245) Cystogram of a diverticulum from the left base of the bladder opening 2 cm. posteriorly and to the left of the left meatus. Resection of the diverticulum

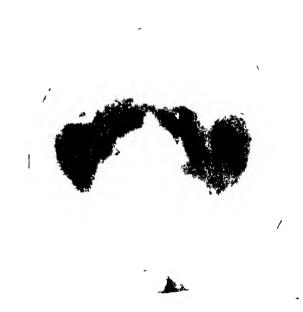


Fig. 2—(206754) Cystogram of a diverticulum from the right base of the bladder opening 2 cm. from the right meatus. Resection of the diverticulum

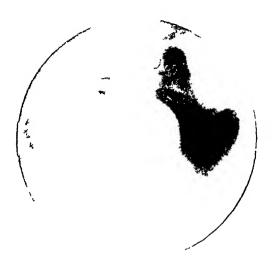


Fig. 3—(214640) Cystogram of a discribilium of the right wall of the bladder opening about 3 cm posteriorly and to the right of the right meetus. Resection of the discribilium

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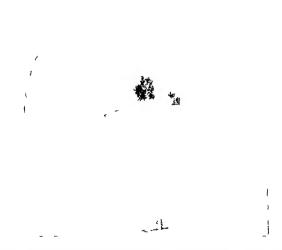


Fig. 4—(206754) Stylet coiled in the diverticulum from the right base of the bladder Opening 2 cm from the right meature. Resection of diverticulum



Fig. 5 —(155042) Stylet coiled in the diverticulum of the right base of the bladder  $\,$  Opening 3 cm  $\,$  from the right meatus  $\,$  Resection of the diverticulum



Fig. 6—(224370) Stylet coiled in the diverticulum from the left lase of the bladder. Opening 2 cm posterior and to the left of the left meatus. Resection of the diverticulum and prostatectom.





Fig 7 -(226631) Diverticulum



Fig. 8 —Same as Fig. 7 Low power section through the entire thickness of a large diverticulum. showing the mucous membrane



Fig. 9 —Same as Figs. 7 and 8 High power showing mucous membrane and strand of smooth muscle of a large diverticulum



Fig. 10—Same as Figs. 7. 8 and 9. Different area from Fig. 9. Showing scarts mucous membrane and strands of smooth muscle.



Tig 11 —(49150) Diverticulum

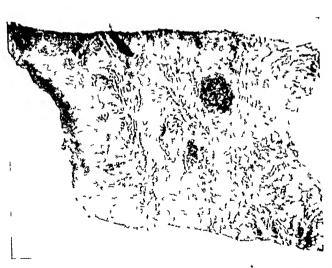


Fig 12 —Same as Fig 11 Low power showing smooth muscle in fat The mucous membrane is absent



Fig. 13 —(206754) Gross photograph of diverticulum

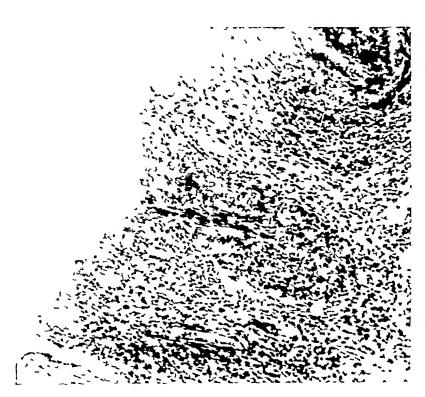


Fig. 14—Same as Fig. 13. High power showing diverticulum. Mucous membrane 1 ith absence of muscie

## DIVERTICULA OF THE BLADDER

diverticula were interfering with both ureters. In our series an instance of this kind has not been observed, though in several instances we have been able to demonstrate that the ureteral meatus was just at the border of the opening of the diverticulum, and that in reality the ureter did open into the diverticulum. In one case the ureter emptied into the sac of the diverticulum, and it was necessary to divide the ureter and reimplant it into the In several other cases in which the ureteral new opening in the bladder opening was marginal the adjoining mucous membrane was turned into the bladder closure, the meatus being preserved. It seems advisable to employ this method whenever it can be done. While a marked trabeculation of the bladder is often seen in cases of diverticula, at the same time it is not at all likely that the trabeculæ will ever become diverticula Diverticula are true pouches, and in a bladder in which they exist there is always residual urine and other evidence of an incapable bladder. It is because of this that the trabeculæ form, just as they often do in cases in which the mability to empty the bladder is due to the obstructing prostate. When the difficulty is overcome by removing the diverticula, the trabeculæ disappear, as in prostate cases when obstruction is removed (Figs 1-6)

## CLASSIFICATION OF DIVERTICULA

Diverticula have been classified as congenital and acquired The congenital type was formerly thought to be those in which all coats of the wall of the bladder were involved in the diverticulum, the acquired type had a sac composed of mucous membrane only (Figs 7-14) fication, made by Englisch some time ago, would not, I think, hold according to most observers at the present time. It seems to be the consensus of opinion that a congenital deformity, or lack of development, is a factor in all of these cases However, there seem to be two distinct types, one in which the diverticulum is associated with an enlargement of the prostate, and which has led some observers to believe that it is the result of the obstruction from the prostate, and the other type occurring in much younger men, in which there is no evidence of obstruction from any cause latter patients will frequently have more residual urine than those with an enlarged prostate and a diverticulum. In either of the two types, the diverticula may be multiple, though usually there is a large sac and one or more small ones

Many cases have been cited to show that obstruction is not a factor in the causation of the condition. It has been demonstrated repeatedly that in case there is an obstructing enlargement in the prostate associated with diverticulum of the bladder, that the removal of the obstruction will not relieve the situation, and, furthermore, that the removal of the prostate and diverticulum will completely relieve all symptoms. I wish to emphasize this point particularly because I believe that many of the patients with prostatic trouble, who continue to have the so-called cystitis and residual urine after the obstruction has been removed, are, in reality, suffering from

diverticula, and that if a careful examination is made for a diverticulum at the time of the prostatectomy in such cases this error will be avoided. I feel certain that we have overlooked a number of diverticula among the prostatic patients, and that many are now receiving irrigations of the bladder, and catheterizations under the assumption that the symptoms are produced by cystitis, when in reality they are caused by the diverticula

Whether the sac is composed of all the coats of the bladder, or whether it is composed of the mucous membrane alone, does not seem to draw a line between the etiology of the congenital and acquired types in these cases There must be some congenital defect which will allow these sacs to develop, though their development may be aided and increased by an obstruction to the urinary outflow. In the young man with this condition, the bladder is usually large, but the wall is not particularly thick, and may appear quite In the type occurring in older men, especially with prostatic trouble, the wall of the bladder is very thick from hypertrophy. In such cases, the sac is adherent and firmly attached to the side of, or beneath, the thick bladder, and there will frequently be much pericystitis and evidence of old and recent infection, without perforation. This usually exists in the cases in which the sac lies between the bladder and the rectum young men, the sac is thin, and is not firmly attached in the surrounding tissues, so that it is readily separated with very little dissection Stagnation in the dependent sac favors infection, which results in diverticulitis and consequent cystitis It has been our experience that in the infected case, apparently the greatest degree of infection is in the sac, though there is all the evidence of infection in the bladder as well It is not unusual, in dilating the orifice of the diverticulum, to see thick pus escaping into the bladder, giving the appearance of opening an abscess under tension and diverticulitis are always present to some degree in the case of the thickwalled sac Calculi are often found in the sac, as was the case in four of our patients In one of our cases, previously reported by Martin, a dumb-bell shaped stone, partly in the bladder and partly in the sac, was found was carcinoma in the sac in one of our cases, and carcinoma and stone in another

#### CLINICAL FEATURES

Diverticulum of the bladder occurs almost exclusively in the male, very few cases have been reported in the female. The characteristic feature of the clinical syndrome is a feeling that the bladder is not emptying. This comes on almost immediately after voiding, with the ability to repeat the act of voiding and the second time to pass a considerable amount of urine Urination may be painful, particularly if the diverticulum is large. The sac may be palpated in some cases, especially through the rectum. Frequency and burning with difficulty of urination were present in most of our cases. Such symptoms always occur in cases after infection has taken place. Patients with diverticula have all the features of marked cystitis, and often

## DIVERTICULA OF THE BLADDER

are treated over long periods for this condition. It is almost a pathognomonic sign of diverticulum to have a considerable amount of urine, thick with pus, escape from the catheter just at the time the bladder was supposed to be entirely clean. The urine in these cases is very foul, and on opening the bladder to perform a prostatectomy or drainage operation, should this foul urine be detected, a diverticulum should be suspected and looked for. In the long-standing case, evidence of a kidney infection, and insufficient renal function, becomes marked. A low percentage of phenolsulphonaphthalein return is not a definite contra-indication to surgical treatment in all of these cases, many of the patients do well in spite of this condition

## DIAGNOSIS

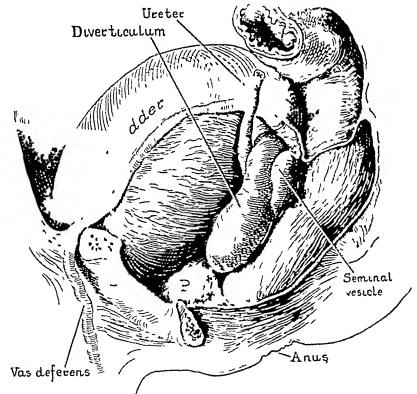
While the diagnosis is suggested by the clinical features, the accurate determination of the condition rests with the cystoscopic examination, and the employment of the leaded catheter and X-ray, or by the making of a cystogram which is of great value in any doubtful case. The cystoscope will usually reveal the condition, though in the case of an enlarged prostate, or in very marked cystitis when the mucosa of the bladder is greatly congested and distorted, it may be impossible to see the opening through the cystoscope, and a cystogram should then be made. In other instances the opening of the diverticulum into the bladder is very small and difficult to see, but the colloidal silver solution will readily pass into it and the diverticulum can be seen when the rontgenogiam is made. In any very marked case of cystitis in which the bladder is to be drained, a diverticulum should be searched for, even if these methods of examination fail to show one, as it is possible that the opening might be closed and the diverticulum not recognized at the time of the examination. In view of the fact that I have had a great deal of difficulty in making a diagnosis in some of these cases, particularly in those in which there was an obstructing enlargement of the prostate, it seems well to emphasize the necessity of a careful exploration of the bladder at the time of performing the prostatectomy in cases showing marked cystitis and infection at the time of the examination. A diverticulum should be suspected in the patient who has had a prostatectomy and still has a considerable amount of residual urine, particularly if there is much evidence of infection which does not respond to the ordinary treatment

The present report is based on a group of 44 patients, operated on between February, 1908, and March, 1918. All of the patients were males, varying in age from eighteen to seventy-three years. Twelve gave a history of gonorrheeal infection, and 3 of the 12 had been treated for stricture of the urethia. There is no evidence to show that the infections or strictures were in any way responsible for or had anything whatever to do with the formation of the diverticula. Six of the 44 patients had been operated on previously for these symptoms without relief. Eight of the patients gave a history of some form of trauma, which might have been a factor to consider in the etiology, but the association was too remote to prove that

the trauma had anything to do with the weakening of the wall of the bladder, or in any way to have been a cause of the diverticula. We believe the trauma was merely incidental. Seventeen of the patients also had an enlargement of the prostate, and the remaining 31 had cystitis, graded at least three on a scale of 4. There was stone in the bladder in 6 of the patients, and carcinoma in 4, in one the carcinoma originated within the diverticulum. At operation the opening of the diverticulum was found in the floor of the bladder, or on one or the other of the lateral walls not far from the ureteral opening in 39 of the 44 patients, which shows that a large percentage of such diverticula originate in one of these regions. The greatest number, 19, were found near the base of the bladder on the right wall. Bladder trabeculation, 3 on a scale of 4, was noted in 38 of the 44 patients.

#### TREATMENT

In reviewing the literature, and from our own records, it stands out clearly that palliative treatment and any other form of treatment other than excision of the diverticular sac, has not given good results. A mortality as high as 83 I per cent has been reported in cases in which there was a diverticulitis at the time of the operation This percentage has been very greatly reduced In the young man without infection, the results are uniformly good, though complete recovery may be slow. In some of our cases the wound was slow in healing, and in others several ounces of residual urine persisted for a number of weeks, though eventually it almost entirely cleared up Something can be accomplished by preliminary washings of the bladder, and by employing methods to stimulate renal function in cases in which it seems necessary Those who have had the most experience with these cases seem to be unanimous in the feeling that the proper treatment for any of these diverticula is complete excision of the sac, and that any treatment less radical will not be satisfactory Our experience bears this out Intravesical treatment, as can be readily seen, is of no avail except as a palliative when operation is contra-indicated, or preliminary to operation Drainage of the bladder, even as a preliminary step, will seldom help enough to warrant its being done We have drained a number of times in these cases, both at the time of the prostatectomy and when the diverticulum was the only lesson I now believe that it is far better, under ordinary circumstances, to remove the diverticulum at the same time Suprapubic dramage of the bladder, even when the dramage tube extends into the diverticulum and is left there for a long time, will not help permanently So far as I am aware, the less radical operations, such as enlarging the opening of the diverticulum and doing a plastic operation on the opening, and of anastomosing the diverticulum to the bladder, are not satisfactory Therefore the treatment resolves itself into the excision of the diverticulum as soon as the patient's general and local condition has been improved as much as possible



Pig 15 —Diagrammatic sketch showing the relation of the diverticulum to the bladder prostate rectum seminal vesicle and ureter

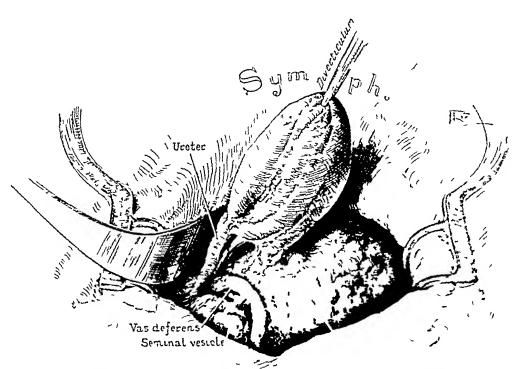


FIG. 16 —(215976) Relation of the reck of the diverse cular to the uncher and was deferent af or the suc of the diverticulum has been dissected out from beneath the blacker.

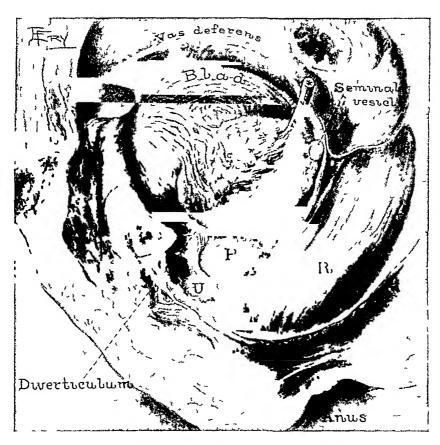


Fig. 17—(215976) The situation of the diverticular sac on the left posterolateral wall and at the base of the bladder — The ureter enters the sac instead of the bladder — The cavity of the sac is approximately half the size of the bladder cavity

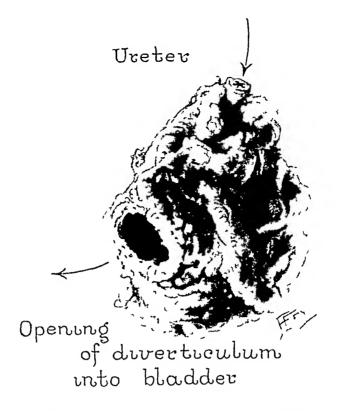


Fig. 18 — Diverticular sec and its opening which communicates with the bladder. Note the ureter entering the sec.



Fig. 10—(215076) The diverticulum after it has been cut in half. Note the communication opening into the bladder and the entrance of the ureter into the diverticulum.

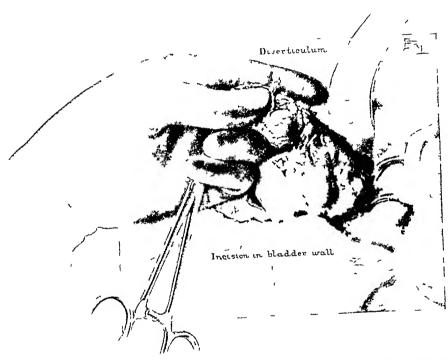
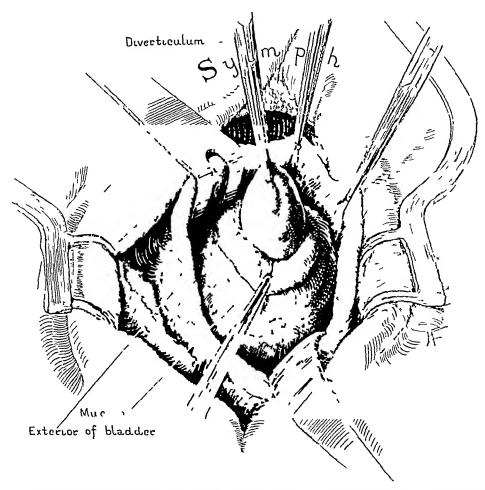


Fig 20 —Finger passing through the incision in the dome of the bladder into the neck and cavity of diver ticulum. The diverticulum being lifted out of the surrounding prevesical tissues.



 $\Gamma$ 16 21 —Transvesical operation for diverticulum of the bladder. The diverticulum is not adherent and is tracted into the bladder by homostats

#### DIVERTICULA OF THE BLADDER

The operation consists in first making a fairly good-sized opening into the bladder through the prevesical space, and locating the opening of the diverticulum, after all the pus and infected mucus has been cleared away The prevesical tissue should be protected against infection in every way Ingenious methods have been devised for filling the diverticulum with an air-filled rubber bag (Lerche) and also for filling the sac with gauze (Lower) which is packed into the sac beforehand, to facilitate its removal Such devices seem to help considerably Whenever possible I prefer to pass one or two fingers into the diverticulum, and then make the dissection through the prevesical tissues down on to the sac, which is also being lifted out by the fingers within it This method is not new, it can be employed in almost all cases, and is especially helpful when the sac is firmly attached to the surrounding tissues If the sac lies high up and is covered by pentoneum, it may be best to open the peritoneum, though, as a rule, this is not necessary After the sac has been completely freed from the surrounding fatty tissue, the neck is severed, the opening in the bladder is closed, and a drain is placed in the prevesical space which the sac occupied suprapubic opening in the bladder is closed, with the exception of the place for the drainage tube The difficulties of the operation lie in separating the sac from the surrounding tissue, particularly if the sac is thick-walled, and if there is a great deal of old infection and scar tissue The vas deferens and the ureter, both of which will come into view in many of the dissections, should always be avoided (Figs 15 and 16) Occasionally it will be necessary to divide the ureter and reimplant it in a new area in the bladder, as I did in one of our cases (Figs 17-19, Case 215,976) If there is an enlargement in the prostate, it should be removed at the same time (Figs 20 and 21)

In this series of 44 patients, so far as we have been able to determine, all but ten are living. Two of the patients died within a few days after a diamage operation, both of these men had septic kidneys and drainage was of no avail. The other deaths occurred after the patients had been up and around for some time, and in most instances after they had gone home. The general and functional results in the remaining 34 patients have been uniformly good. The functional result, insofar as emptying the bladder is concerned, may be slow to adjust itself, though eventually it will be practically perfect.

Summarizing, briefly, it may be said, that diverticulum of the bladder is much more common than has been realized, and that the condition is perfectly amenable to surgical treatment

FORTY-FOUR PATIENTS OPERATED ON FROM FEBRUARY, 1908, TO MAPCH, 1918 YOUNGEST, 18 YEARS, OLDEST, 73 YEARS, AVFRAGE AGE, 52 YEARS

Cases

## E S JUDD

	Cases
Previous operation on the bladder (elsewhere)	5
Previous perineal prostatectomy (here)	1
Symptoms dating from previous trauma	8
Enuresis since childhood	2
FIRST SYMPTOMS NOTED	•
Hæmaturia	8
Difficulty in urinating	15
Frequency	21
SYMPTOMS	
Repeated urination	5
Hæmaturia	14
Pyuria	17 26
Burning on urination	35
Frequency Difficulty in urinating (catheter used in 9)	24
Loss of weight noted	18
Average loss of weight, 15 pounds	
	ar
Cystoscopic examination in	35 17
Hypertrophied prostate found in Cystitis (average 3)	31
Bladder stone	<b>.</b>
Stone and carcinoma	2
Carcinoma (carcinoma in diverticulum in 1)	2
Cystoscopic localization of the diverticulum	35
Dome of bladder	3
Left wall and base	11
Right wall and base	12
Base	3
Multiple diverticula of base	6
URINALYSIS	
Рушта	25
Hæmaturia and pyuria	17
Location of the diverticulum at operation	45
Right wall and base (10 near right ureter)	19
Left wall and base (6 near left ureter)	11
Left ureter in diverticulum	1
Floor and base	11
Dome	3
Bladder trabeculation, average 3	38
Bladder stones	7
Carcinoma	3
Carcinoma and stone Hypertrophy of the prostate	2
Stones in the diverticulum	18
Carcinoma in the diverticlum	4
Carcinoma and stones in the diverticulum	- I
TYPE OF OPERATION	_
Intraperationeal resection of the diverticulum	2
Extraperitoneal resection of the diverticulum	16
Extraperitoneal resection of the diverticulum and prostatectomy	7

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## DIVERTICULA OF THE BLADDER

Ca	ECS
Extraperitoneal resection of the diverticulum, prostatectomy and removal of stones	1
Extraperitoneal resection of the bladder for cancer, prostatectomy and resection of	
the diverticulum	I
Extraperitoneal resection of the diverticulum and transplantation of the ureter	1
Dramage of the bladder and prostatectomy	5
Drainage of the bladder and removal of stones	6
Enlarging the opening of the diverticulum and drainage of the bladder	4
Separation of septum between bladder and urethra	1

#### DEATHS REPORTED IN THE FORTY-FOUR CASES, IO

Type of Operation	Length of Life	Cause of Death		
Dramage of bladder	2 days	Pyelonephritis		
Dramage of bladder	4 days	Acute septic nephritis		
Drainage of bladder and prostatectomy	25 days	Bilateral pneumonia		
Extraperitoneal resection of diverticulum	28 days	Pulmonary embolus		
Extraperitoneal resection of diverticulum	I month	Pyelonephritis		
Drainage of the bladder	2 months	Pyelonephritis		
Drainage of bladder and removal of stone (carcinoma in the diverticulum)	2½ months	Pyelonephritis and peri- vesical abscesses		
Enlargement of opening in diverticulum	9 months	Not known		
Extraperitoneal resection of the diverticulum con-				
taining carcinoma	12 months	Not known		
Drainage of the bladder	36 months	Not known		

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# A NOTE ON THE TREATMENT OF WOUNDS OF THE GENITAL ORGANS IN WARFARE

## By Charles Greene Cumston, M D

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Wounds of the scrotum and testicle by missiles are, on the whole, relatively frequent in this war, and of course they may be accompanied by variously serious lesions of the neighboring organs. The lesions encountered offer various degrees of destruction and the complications, likewise, are many

There may be merely a simple contusion of the scrotum, giving rise to a hæmatoma or traumatic orchitis. Not infrequently there is a simple wound of the scrotum, with or without some foreign body lodged in its cavity, with or without lesions of the urethra or hernia of the testicle

As to the seminal gland, it may be simply contused or partially or totally destroyed. The vas deferens may be involved, that is to say, contused or divided, and I know of one case in which the penis was dislocated at the same time.

The symptoms are not usually very marked and can be summed up in slight pain, a trifling external hemorrhage, and an hæmatic tumefaction which may be quite manifest. Hernia of the testicle may be primary or secondary

To one point I would call particular attention, and that is that death may occur from infectious complications or from associated lesions. Wounds of the scrotum are recovered from with ease and this also applies to traumatic orchitis. However, when hernia of the testicle arises, three eventualities are to be looked for, viz (1) the organ may slough, (2) become reduced spontaneously (as in the case of cerebral hernia), and (3) become grafted on a neighboring area

When the testicle is injured to an extent beyond repair, castration must be done, but it should not be forgotten that repair may take place, although this is very likely to be followed by partial or even total atrophy of the gland. As a late consequence obstinate neuralgia may ensue, while should both testicles be injured, phenomena of eunuchism are prone to arise. Therefore, the prognosis, so far as the ultimate outcome of the case is concerned, must be more than guarded

There are hardly ever two wounds quite the same in nature, and in each and every case, the technic will vary, according to the indications. There is a rule in these cases, which never suffers an exception, namely that conservative surgery must be foremost, for these subjects are young adults, in full genital maturity, and are to be called upon later on to play an important part in the future life of their country. The reader may smile at

## WOUNDS OF THE GENITAL ORGANS IN WARFARE

this remark, but could my countrymen but know the minute care that has been taken by Germany and her subservient allies for the breeding of future "cannon food," he will do well to think twice of what I say

In contusion of the scrotum, the treatment is usually a simple matter Moist humid dressings applied with very slight compression are usually quite sufficient to subdue the pain and tumefaction. Should the swelling not quickly decrease, this fact indicates that there is either a hæmatoma of the scrotum or an hæmatocele of the vaginalis, an indication for incision and drainage without awaiting future developments which will surely be of septic nature, and at the same time any bleeding vessel can be ligated

Should the reaction of the vaginalis have resulted in the production of a hydrocele, this morbid process is to be dealt with according to rules known to all Small wounds of the scrotum heal with ease by the use of moist dressings, but in cases of Jarge loss of scrotal tissue, simple dressings are inadequate and skin grafts must be made, which, in this region, take readily

If a missile or other foreign body is lodged in the scrotal cavity it should be removed at once, which is a simple matter and requires no particular skill, but the treatment becomes a much more delicate question when the testicle is involved. Not uncommonly the gland, be it either intact or injured, forms a herma through the aperture in the scrotum

Now, no hesitation is permissible when the testicle is untouched or only slightly contused, because the only rational treatment is its reduction into the bursa and suture of the latter. The reduction should be attempted just as soon as possible in order to avoid strangulation and its shadow, sloughing, which always follows. The reduction may be delayed for a few days until the scrotal wound has been properly cleansed if it appears to be infected as is usually the case, but at the same time, the vitality of the testicle must be carefully watched

When reduction is undertaken, the utmost gentleness must be observed After having carefully cleansed the structures, the lower or upper angle of the scrotal wound must be enlarged by incision and the ragged edges of the vaginalis carefully evened off with scissors. With the exit of the testicle from the scrotum, all the tunics will, of necessity, be turned outward, therefore, since in the circumstances the vaginalis will form a virtual cavity, the testicle can be reintegrated if the walls of the vaginalis are first raised up and retracted

In cases seen shortly after the receipt of the injury, it may be possible to reintegrate the testicle under its serous covering, otherwise the gland must be covered by any means possible, such as a moist dressing, and then await events. Not uncommonly, the congestion will subside in a few days, the surrounding structures will relax and the general aspect of the process will assume an aspect of excellent behavior, far from what might have been assumed when the case first came under observation. Admitting that the

#### CHARLES GREENE CUMSTON

testicle and its vessels are intact, irreducibility is never an indication for primary castration

There is every reason to attempt reduction, even when the testicle is contused or offers a superficial wound. The parenchyma forming the hernia should be carefully reduced and the albuginea minutely sutured. One can never surmise just what this conservative treatment may hold in surprise, but the great value of the organ in question cannot but incite one to attempt conservative lines.

Such conservative treatment is out of the question when the testicle has been outside the scrotal cavity for some time, in which case it will be found to be dark in color, dried and withered. Likewise, when greatly injured, it will have emptied its contents and is reduced to a fibrous shell. In these circumstances the tissues are infected of necessity and septic complications are imminent. Therefore, the removal of the gland becomes imperative.

When considering the question of castration for any motive whatsoever, account should be taken of the condition of the fellow organ, which may in its turn be compromised in the injury

The same principles must be our guide in the ultimate treatment of painful phenomena arising after traumata of the testicle. The pain may result from atrophied or greatly traumatized testicles, but as all this is new experience for surgeons, and as sufficient time has not elapsed for reliable data to be accumulated, we must await final judgment

Not infrequently, neuralgic paroxysms have their starting point in the testicular stump, so that an interference for its relief is indicated if the fellow organ is healthy. But when only a portion of a testicle remains, the other organ having been destroyed by trauma, one should advise the patient to essay all medical means at our disposal in order to save, if possible, the remains of one testicle

As to operative interference in wounds of the vas deferens, which is often the seat of a lesion, as well as those occurring in the scrotal urethra. Of the vas, there is little to be said. Some cases of suture in case of division of the duct have been done, but as yet we are ignorant of the ultimate outcome of these patients.

As to retention of urine of reflex nature, a few séances of aseptic catheterization will generally control the situation. Suprapubic cystotomy should be done for retention of urine following an injury to the urethra (I am, of course, only considering the treatment of these cases at an ambulance, not at a base hospital), and at a few days later the urethra can be repaired by some one of the many methods at our disposal, upon which it is quite unnecessary to insist

# ANATOMICAL METHODS OF APPROACH IN OPERATIONS ON THE LONG BONES OF THE EXTREMITIES\*

By James E Thompson, MB, FRCS (Eng) of Galveston, Texas

To insure absolute safety in the performance of surgical operations four requisites are necessary in the operator First, sound anatomical knowledge, second, accurate pathological training, third, technical skill, and fourth, wellbalanced judgment Each is so important in its particular way and all are so interdependent that the loss of one of them will belittle the value of the For a number of years past it has been a matter of observation that many surgeons were showing a tendency to drift away from the traditions of the old school as to the necessity of a profound anatomical training as a stepping stone to the career of a surgeon. The repeated assertion that "a good anatomist was often a timid surgeon" came to have a meaning that the timidity was a direct result of the anatomical training, which we must admit is a very fallacious conclusion to draw Observation will support the statement that the men who have left the greatest impress on scientific surgery have achieved it by contributions to anatomical improvements in technic and by additions to our knowledge of surgical pathology And of these two the former is by no means the least important Witness the development of the modern operations for supravaginal hysterectomy and the Wertheim operation for cancer of the uterus, and compare them with the crude procedures in vogue thirty or more years ago. In every direction we are paying more attention to anatomical details, the aim of the surgeon being to complete the operation with the least possible hurt to the surrounding structures Some operations, such as those for radical cure of hernia, for the removal of cervical glands and the complete breast operation, are models and triumphs of clean dissection

In visiting the important clinics of the country one cannot help being impressed by the fact that wonderfully good surgery is performed on the abdominal viscera and in some places an unusual degree of skill is shown in neck operations. On the other hand, with a few exceptions the work done on the arms and legs is not of the highest order. This deplorable condition is the result partly of want of practice and partly of deficient anatomical knowledge. During an experience of over a quarter of a century of teaching operative surgery on the cadaver to successive generations of senior students, I have clung tenaciously to the old traditions of insisting on a thorough course in the surgical anatomy of the typical operations, such as ligature of arteries and exposure of nerves and tendons, before allowing the students to include in the atypical operations in the abdomen and elsewhere. The course has assumed the importance of an advanced course in surgical anatomy

<sup>\*</sup>Read before the American Surgical Association, June 7, 1918

## JAMES E THOMPSON

of the extremities and head and neck. As a repetition of work previously touched on in the Junior year it has caused a little resentment as being superfluous. I have felt, however, that I was putting the finishing touches to an excellent anatomical training and that I could conscientiously sign my name to the diploma and certify that the recipient was reasonably safe to practise surgery. The expressions of gratitude that reach me constantly from my old pupils, as to the benefit of this training, have convinced me that the course has been a wise one, and consequently it is still followed.

During this period I have had constant opportunity of studying anatomical regions from the point of view of contemporary surgical procedures and of modifying my views as to the best way of exposing the bones and other structures. One important fact was early impressed upon me, namely, that pure anatomical facts which have apparently little surgical significance to-day may become of great importance to-morrow. The moral of which is that one cannot store one's mind too compactly with anatomical truths

During the last few years I have interested myself with the long bones and the best routes by which they can be reached, and the following communication is the result of my studies

The following conditions may call for operations on the long bones

- (1) Fractures in all phases, open or closed, recent or of old standing, ununited or united with deformity
  - (2) Osteomyelitis, acute or chronic
  - (3) Deformities, such as occur in rickets, bow-legs, knock-knee, etc
- (4) In orthopædic surgery, to attach silk ligaments or fascial strips to alleviate paralytic forms of talipes
  - (5) Tumors, such as chondroma, osteoma, cysts, sarcomata

Some of these affections, such as osteomyelitis and some of the tumors, have a predilection for the neighborhood of the epiphyseal lines and epiphyses, a fact which makes it necessary for us to be familiarly acquainted with the relationship of the epiphyseal lines to the joint cavities and the lines of reflexion of the synovial membranes For example, the epiphyseal line of the proximal end of the femur lies entirely within the joint, the line of reflexion of the capsule being far distal to it in front and behind, a condition of affairs which is responsible for the frequency with which the hip-joint becomes secondarily infected in chronic osteomyelitis of the head of the femur Further, the proximal end of the shaft which is represented by the neck of the femur in contact with the epiphyseal line is occasionally affected with acute osteomyelitis This also lies inside the capsule and the diseased focus may point directly into the joint cavity and not burrow as it often does along the shaft below the line of attachment of the capsule epiphyseal line of the upper end of the humerus is within the capsule on its medial, but outside it on its lateral aspect. As a rule foci of acute osteomyelitis point outside the other large articulations

In exposing the long bones the following principles must be scrupulously observed

- (1) Easy Access to the Site of Fracture or Focus of Disease—As far as possible we should try and avoid deep wounds where shallow ones will suffice, but if anatomical structures are less damaged by employing deeper dissections, preference must be given to the latter
- (2) Preservation of All Nerves Both Sensory and Motor —It might seem a superfluous refinement to allow a cutaneous nerve to influence us in the choice of an incision, but wherever possible, even cutaneous nerves should be preserved. Thus patients will often complain bitterly of numbness after complete division of cutaneous nerves, especially those supplying the hands and feet. Partial division of a cutaneous nerve is often followed by neuralgic symptoms of an intractable nature. The preservation of the motor nerves is a vital necessity. Upon this, more than on any other factor, does the future usefulness of the limb depend
- (3) Prevention of Unnecessary Injury to Muscles—As far as possible the approach should be between the muscles—In some instances, however, the muscles may be split parallel to their fibres without doing any permanent damage. As an example the lower portion of the triceps brachii may be split for a considerable distance above its insertion without serious damage to its function. In situations where the fractured ends of the bones are covered by a transverse muscle, as in the upper end of the radius (supinator), an attempt should be made to peel the muscle from the bone and retract it upward or downward rather than to divide it. If it is necessary to divide a muscle the line of incision should be made as far as possible from the point where its nerve supply enters it.
- (4) The Preservation of the Vascular Supply—It is always wise, other things being equal, to choose a route remote from the blood-vessels. When this is impossible, they should be protected with the greatest care. To deprive a muscle or a group of muscles of their proper amount of blood will retard both the healing processes and the ultimate return of function on which the future of the limb depends

Further, it must be borne in mind that any injury of the nutrient arteries of the bones must be avoided. This will entail careful consideration as to their origin from the main trunks and the situations where they enter the bone. Extensive denudation of the fractured ends of the bone should be avoided for the same reason.

#### THE UPPER EXTREMITY

The Radius—1 Distal Extremity—This consists of the lower epiphysis and the contiguous part of the diaphysis. The epiphyseal line is entirely outside the articulation. The posterior surface of this extremity is occupied by grooves for the extensor tendons of the fingers, thumb and wrist (Fig. 1). The anterior surface is covered deeply by the pronator quadratus muscle and the tendinous insertion of the brachio-radialis, also by the radial artery and the superficial and deep flexor muscles. The medial surface is opposed to the ulna with which it articulates. The lateral surface is prolonged into the styloid process on which is found a groove which is occupied by the tendons of the abductor pollicis longus and the extensor pollicis brevis. Into the proximal parts of the anterior and posterior lips of the groove and to

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its floor the tendon of the brachioradialis is inserted. This surface is the only really accessible part of the lower end of the radius and it can be exposed by an incision carried vertically upwards from the anterior margin of the styloid process. The tendon of the brachioradialis will be exposed having medial to it the radial artery. If the artery be retracted, the pronator quadratus will be seen. The radius will be exposed between the brachioradialis insertion and the pronator quadratus (Figs 2 and 4). This will enable the lower epiphysis and the neighborhood of the epiphyseal line to be reached with ease and safety, and also is an accessible route for osteotomies in some cases of badly set Colles' fractures.

The higher parts of the lateral aspect of the distal end of the radius can be more easily reached by a deep dissection between the brachioradialis anteriorly and the extensor carpi radialis longus posteriorly. In fact, the lateral aspect of the lower third of the radius can be safely exposed by this route The following are the steps of the dissection (Fig 3) Expose the tendon of the brachioradialis, and retract it anteriorly. The tendon of the extensor carpi radialis longus comes into view, passing vertically downward This is crossed obliquely just above the base of the styloid process by the abductor pollicis longus muscle and below this by the extensor pollicis brevis Retract the extensor carpi radialis longus medially and the abductor pollicis longus distally. This will expose the lateral aspect of the radius as far as the groove in the styloid process If more exposure is needed the tendon of the brachioradialis can be peeled from the bone and re-attached after the operation is completed. By this procedure a larger area of bone can be exposed, but it perhaps imperils the tendinous groove in the styloid process (Fig. 1)

The posterior surface is covered by the dorsal carpal ligament and is grooved by the following tendons in order from the medial to the lateral side the extensor digitorum communis, the extensor indicis proprius, the extensor pollicis longus, the extensor carpi radialis brevis and the extensor carpi radialis longus (Fig 1) Superficial to these we find the dorsal carpal ligament binding the tendons down in their grooves Above the upper edge of the dorsal carpal ligament there is a small area of the lower end of the radius that could be exposed by a careful dissection carried along the lateral border of the extensor digitorum communis tendon The deep dissection after medial retraction of the digitorum communis would expose the extensor pollicis longus, passing downward and laterally under the dorsal carpal ligament Just above the upper border of the dorsal carpal ligament a triangle can be made out, the base of which is formed by the upper border of the carpal ligament, the lateral side by the extensor pollicis brevis, and the medial side by the extensor pollicis longus (Fig 5) In the floor of this triangle, a part of the posterior surface of the radius and the tendon of the extensor carpi radialis brevis can be seen The area of bone exposed is very small, but can be enlarged by retraction of the short and long extensors of the thumb It would hardly be wise to choose this route as a deliberate method of exposure except in rare circumstances, because it would expose the extensor tendon sheaths to the risk of damage and possible infection Even in the cadaver it is a difficult matter to dissect this space without opening some of the synovial sheaths of the radius beneath the dorsal carpal ligament is grooved by the extensor tendons and is, surgically speaking, inaccessible

2 Shaft—Anterior surface The proximal end of the anterior surface of the shaft is very deeply situated, being covered by the brachioradialis muscle and the muscular masses attached to its surface. The distal end is nearer the surface. The base and anterior edge of the styloid process are subcutaneous. The whole of the surface from the neck proximally almost as far as the articular margin distally is covered by the following structures in order (Fig. 2). Biceps tendon (insertion), supinator (insertion), flexor digitorum sublimis (origin), pronator radii teres (insertion), flexor longus pollicis (origin), and pronator quadratus

## OPERATIONS ON LONG BONES OF EXTREMITIES

(insertion) The radial artery with its venæ comites lies on all of these structures and at the distal border of the pronator quadratus the artery lies on bone brachioradialis muscle is superficial to the radial artery in the proximal third of the forearm, but gradually passes to the lateral side to reach its insertion ficial to the pronator quadratus muscle we find the tendons of the flexor carpi radialis, flexor pollicis longus and the lateral tendons of the flexor digitorum sublimis (Fig 4) It is evident that the proximal third of the anterior surface is inaccessible, owing to its great depth and anterior relations The middle third is also quite deep but could with a little difficulty be exposed by the following Incision of the deep fascia along the medial border of the brachioradialis and retraction of that muscle to the lateral side of the forearm would expose the insertion of the pronator radii teres and the radial origin of the flevor digitorum sublimis By dissecting between these two muscles and, if necessary, peeling the sublimis medially from its insertion, and the underlying flexor pollicis longus along with it, the surface of bone would be laid bare (Fig 2) lower third a considerable area of bone could be exposed safely by dissecting to the medial side of the brachioradialis tendon. A strip of bone reaching from the insertion of the pronator radii teres to the base of the radial styloid process, lying lateral to the origin of the flexor pollicis longus and the insertion of the pronator quadratus would be accessible (Figs 2 and 4) The lower part of this area has already been described in the section dealing with the surgery of the distal end of the hone

Posterior surface This surface in its proximal half is not so deeply imbedded in muscles as the anterior surface. A study of Fig. 1 will show the muscles attached The insertion of the supinator muscle occupies nearly all the proximal third Distal to this, in order, we find the origins of the abductor pollicis longus and the extensor pollicis brevis arising from a strip on the medial half of the bone site the origin of the abductor pollicis longus we find the insertion of the pronator radii teres into the lateral margin of the shaft along a narrow roughened ridge The part of the shaft below the insertion of the pronator radii teres to which no muscles are attached is covered by the fleshy bellies of the abductor pollicis longus and extensor pollicis brevis on their way to the groove on the outer aspect of the styloid process Between the origin of the abductor pollicis longus and the insertion of the pronator radii teres, a narrow strip of bone is seen to which no muscle is attached This is continuous with the This narrow strip of bone and a considerable area large bare area below of the bare surface below it can be exposed by the following procedure. The lateral border of the extensor digitorum communis tendon is exposed, at a point corresponding to the junction of the middle and lower thirds of the forearm, by an incision which follows a line from a point corresponding to the middle of the posterior aspect of the wrist to a point about a finger's breadth anterior to the external epicondyle of the humerus (Fig 5) If this tendon is followed upward it is easy to separate it from the tendon of the extensor carpi radialis The common extensor of the fingers is retracted medially and the short radial extensor laterally. The abductor pollicis longus is then fully exposed and on the lateral border of the radius the insertion of the pronator radii teres is seen retracting the abductor pollicis longus distally and medially a considerable area of the posterior surface of the radius can be exposed (Fig 7) If necessary, this muscle can be peeled from the bone towards the interosseous membrane of Figs 5, 6, and 7 will simplify the understanding of the text the line of separation between the extensor digitorum communis and the extensor carpi radialis brevis and longus as far up as the lateral epicondyle of the humerus (Fig 5) and retracting the former muscle medially, the supmator muscle will come into view as high as the neck of the radius (Fig 6) In this way all the

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muscles arising from the posterior surface of the radius can be exposed. By detaching the origin of the common extensor from the external epicondyle this muscle can be retracted still further medially just as far as the blood-vessels and nerves, which enter it at the level of the lower border of the supinator, will endure the traction. By this manœuvre the annular ligament of the radius comes into view and distal to this a more extended view of the supinator muscle (Figs 6 and 7). The incision from end to end will pass along an area free from blood-vessels of any size and will not imperil the nerve supply of any of the muscles brought into view. By means of this dissection a little more than the proximal half of the shaft becomes accessible for surgical procedures if care is taken in exposing the bone covered by the supinator muscle.

It will be convenient here to describe the nerve supply to the muscles concerned and show how we can avoid injuring them. The radial nerve (O T musculospiral) gives off muscular branches to the brachioradialis and to the extensor carpi radialis longus near their origins, as it lies between them and the brachialis muscle in front of the lower end of the humerus. In the hollow of the elbow it divides into two branches, viz the superficial ramus (O T radial nerve) which is entirely cutaneous in its distribution and the deep ramus (O T posterior interosseous nerve) which is entirely muscular

The superficial ramus passes down the forearm deeply placed under cover of the brachioradialis muscle. It is placed to the lateral side of the radial artery. In the distal third of the forearm it passes backward under the brachioradialis and pierces the deep fascia to become subcutaneous. It may be injured in operations on the lower third of the lateral aspect of the shaft

The deep ramus passes distally and posteriorly It gives off immediately branches to the extensor carpi radialis brevis and to the supinator. It then penetrates the substance of the supinator on its lateral aspect, just below the level of the head of the radius, and lies embedded in the muscular fibres almost as far as its lower border, where it emerges under cover of the extensor digitorium communis to which it gives branches at once (Fig. 7). Then it passes distally under the name of the posterior interosseous nerve, superficial to the abductor longus pollicis and the extensor brevis pollicis, to which it gives branches which penetrate the muscles on their superficial aspects, it then passes deeply under cover of the extensor longus pollicis and the extensor indicis proprius to which it gives branches which penetrate them on their deep aspects. It ends on the back of the carpus under the extensor tendons in a gangliform enlargement.

A study of Fig 7 will show the arrangement of the nerves It will be seen that separation of the supinator and the abductor longus pollicis can be carried to a high point if care is taken of the dorsal interosseous nerve. As a matter of fact, retraction of the extensor communis digitorium is resisted opposite the lower border of the supinator, because both the nerves and arteries enter the muscle at this point. This is the danger zone. Starting from here one can follow the course of the radial nerve, both proximally and distally. The distal portion of the dorsal interosseous is quite slender and is bound down to the posterior surface of the deep muscles by a fairly strong band of fascia which it is unwise to attempt to disturb. The proximal portion courses through the supinator very obliquely. It lies about 2 cm below the joint line on the lateral aspect of the radius and about 5 cm below the line on its posterior aspect.

In actual operative work on the area of bone covered by the supinator, the muscular fibres are usually divided until the radial nerve comes into view when it is carefully retracted. It would be a better plan to peel the muscle from the bone and retract it either proximally or distally. We have proved the feasibility of this both in the dissecting room and at the operating table. One should avoid

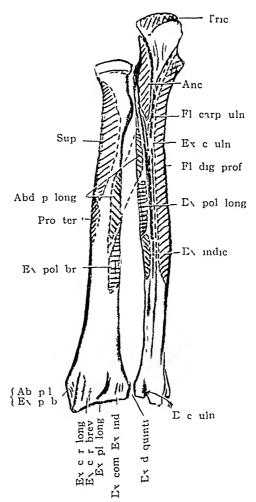
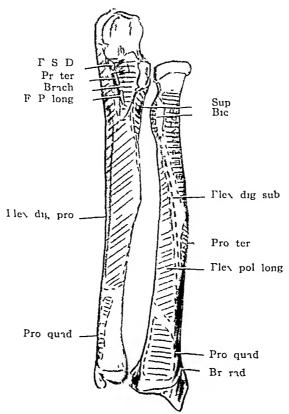


Fig. 1—Posterior view of radius and ular showing origins and insertions of muscles. In the picture of the ular it will be seen that a part of the shaft medial to the posterior subcutaneous ridge is shown with the origins of the flexor carpi ularis and the flexor digitorum profunds. The abbreviations in this and all subsequent figures refer to the new anatomical nomenclature followed by Cunningham. For all the plates I am indebted to Prof. Wm. Keiller. Most are modifications of the excellent plates in Cunningham sharptomy. A few are from Spalteholtz. Some are from original dissections. The sections of the joints are from Beesly and Johnston.



Γις 2 - Anterior view of the radius and ulna

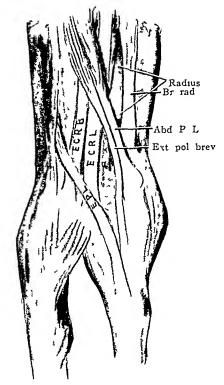


Fig. 3—Posterolateral view of a dissection of the lower part of the forearm just above the wrist. A considerable area of radius can be seen in the interval between the brachioradialis and the extensor carpitadials longus. This area is bounded below by the abductor policis longus (original dissection)

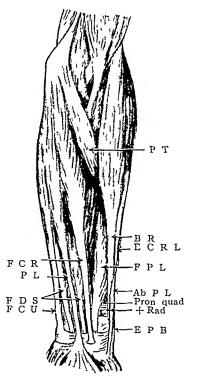


Fig. 4—Dissection of the muscles on the anterior aspect of the forearm and wrist. The arrow marked + Rad points to the medial side of the brachioradialis tendon and its point shows an interval between the brachioradials and the pronator quadratus. By retracting the brachioradialis laterally and peeling the pronator quadratus medially from the surface of the bone a considerable area of the anterior surface of the radius can be exposed.

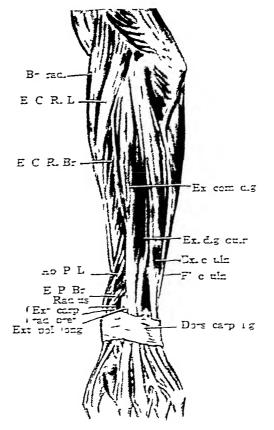


Fig. 5—Dissertion of the mustles of the posterior aspect of the totestm and mist. Above the dorsel curved ligament, a portion of the force end of the radius can be seen fring in an imagular quadrilaters area townseen on the extensor points one is proximate. In the upper part the extensor carp radius premis areas in and the extensor points one is proximate. In the upper part of the arm, the appendix intermediate of the extensor of the extensor

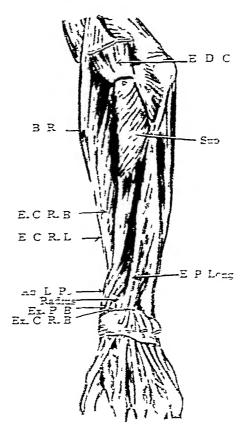


Fig to—Deeper dissection of the mind as on the posterior surface of the foreign. The extension committee has been removed and its order proximator (E.D.C.) thrown upward exposing the feat of the mains RN convert or the annual lighter. The cural end of the mind east from a over the correlation, animent. In clear the laboration of the surface of the minds shown in Fig. 5. The whole extent of origin of the addition polling longuals exposed and proximal to the foreign of the surface of the statistic polling the contiguous margins of the addition polling longuals and the extensor components from one another a considerio earen of the pone can be extensed. This is shown in Fig.

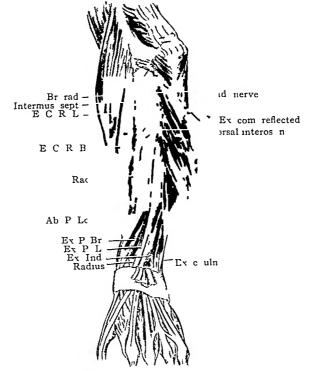


Fig 7—A dissection of the muscles of the posterior surface of the forearm showing (1) an area of radius exposed above the upper edge of the dorsal carpal ligament (2) a large area of the shaft of the radius exposed below the supinator muscle by separating the abductor pollicis longus and the extensor carpitations brevis from one another (3) the course of the radial nerve through the muscular fibres of the supinator (shown by an oblique dotted line) and (4) the exit of the dorsal interoseous nerve from the supinator muscle and the distribution of the muscular branches to the extensor digitorium communis abductor pollicis longus and the extensor pollicis brevis

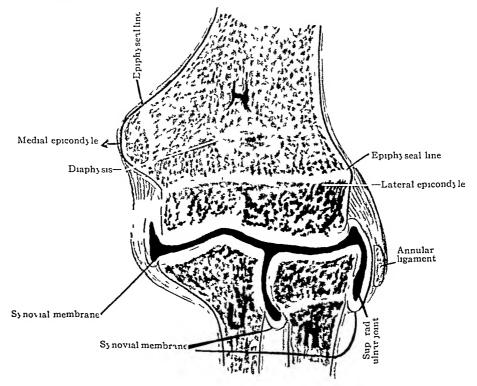


Fig. 8—Represents a coronal section of the elbow joint. The downward growth of the shaft between the medial epicondy le and the trochlear surface is well depicted. The lateral epicondy le is below the epiphyseal line and belongs to the epiphysis. The medial epicondy le does not belong to the epiphysis. It will be seen that the lateral epicondy le is the key to the situation in operations for fixation of epiphysis. The shaft above the epicondyle is accessible on either side along the supracondylar ridge of bone.

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pulling on the nerve too vigorously. In one of our cases the extensor muscles were temporarily paralyzed after a bone plating operation in this region

3 Proximal extremity (head and neck) The upper epiphysis of the radius is entirely within the synovial cavity of the elbow joint (Fig 8) The head of the bone is firmly grasped by the annular ligament which holds it firmly in the radial notch of the ulna The ligament also encircles the proximal part of the neck of the The anterior surface of the head and neck is so deeply placed as to be inacces-Posteriorly the head can be palpated easily and its rotation felt when the forearm is pronated and supinated. On this surface the supinator muscle passes almost as high as the margin of the head Covering both head and neck and supinator muscle is the aponeurosis of origin of the extensor digitorum This part of the bone can be exposed by a vertical incision carried distally from the lateral epicondyle for a short distance By splitting the attachment of the extensor digitorum communis, the annular ligament of the radius and supinator muscle are exposed After cutting the annular ligament the head comes into view If a view of the neck and the contiguous part of the shaft is required the fibres of the supinator are detached and retracted distally or divided The position of the deep branch of the radial nerve must be remembered

## SUMMARY OF CONCLUSIONS

The distal end of radius is accessible (I) In front of the base of the styloid process by passing between the brachioradialis insertion and the radial artery and exposing the bone to the lateral aspect of the pronator quadratus (for Colles' fracture and osteomyelitis of epiphysis)

- (2) Above the base of the styloid process by passing between the tendon of the brachioradialis and the extensor carpi radialis longus. At least the lower third of the lateral aspect of the bone can be explored if this incision be prolonged upwards (for Colles' fracture and osteomyelitis of diaphysis)
- (3) Over a small area of the posterior surface just above the dorsal carpal ligament between the extensor pollicis longus and extensor pollicis brevis (of purely academic interest)

The shaft of the radius is accessible (1) Along the lower third of its lateral border (see procedure No 2 for distal end of bone)

- (2) Along a narrow strip of the posterior surface situated between the insertion of the pronator teres and the origin of the abductor pollicis longus. The dissection passes superficially to the lateral side of the extensor digitorum communis, deeply between the abductor pollicis longus and the extensor carpi radialis brevis. By retracting the abductor pollicis longus a considerable area of the radius covered by this muscle can be exposed. The *middle third of the shaft* can be reached by this route
- (3) The upper third of the posterior surface can be reached by a prolongation upward of the incision in No 2 as far as the external epicondyle. The extensor digitorum communis is separated from the extensores carpinadialis longus and brevis and from the epicondyle and retracted medially. The supinator is exposed and retracted or divided secundum artem

The proximal end of the radius is accessible. (1) From behind by splitting the aponeurosis of origin of the extensor digitorum communis from the external epicondyle by a vertical cut—If necessary open the joint by cutting

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the annular ligament and expose the head of the bone To expose the neck, divide or retract the supinator muscle

THE ULNA-The shaft and both extremities of the ulna are subcutaneous from end to end The epiphyseal line at the distal end of the bone is extraarticular everywhere except over a small area on its radial aspect epiphyseal line is entirely extra-articular. The best method of exposing the bone is along its subcutaneous margin. In the distal part the incision passes between the tendons of the flexor and extensor carpi ulnaris Care must be taken to avoid injuring the dorsal cutaneous branch of the ulnar nerve which passes backward beneath the tendon of the flexor carpi ulnaris and becomes cutaneous in the distal fourth of the forearm In plating fractures near the middle of the bone care must -be taken not to disturb unnecessarily the muscle attached to its anterior surface (flexor digitorum profundus), through the substance of which the nutrient artery passes to enter the arterial foramen which is situated a little proximal to the middle of the bone In operations on fractures of the olecranon process care must be taken not to injure the ulnar nerve As the nerve passes distally between the two heads of the flexor carpi ulnaris it lies on the medial aspect of the base of It may be in real danger during the operation of subcutaneous the olecranon wiring from side to side

THE HUMERUS—I Distal Extremity—The capitulum and the trochlea form the articular surface of the lower end of the humerus They lie entirely within the capsule of the joint The lateral epicondyle (the centre of ossification for which appears about the twelfth year) rests in close contact with the capitulum and lies outside the synovial cavity The capitulum, trochlea and lateral epicondyle form the lower epiphysis The medial epicondyle (the centre of ossification of which appears about the sixth year) is separated from the centres of the lower epiphysis by a growth downward of the shaft of the bone (Fig 8) attachment of the synovial membrane follows the lateral margins of the capitulum fossa radialis on the lateral side, thence passes up almost to the apex of the coronoid fossa and thence down to the margin of the trochlea on the medial side On the posterior surface the attachment follows the margin of the capitulum until it reaches the edge of the trochlear surface, thence upward to the apex of the olecranon fossa and downward to the medial margin of the trochlea Fig 8 shows accurately the relationship of the lower epiphysis to the shaft and to the synovial cavity The epiphyseal line is a considerable distance outside the joint line on the lateral side and just outside it on the medial side In front and behind, the epiphyseal line is intra-articular. In cases of separation of the lower epiphysis the lateral epicondyle, which forms part of it, is also displaced. The medial epicondyle remains attached to the shaft. Both radial and ulnar collateral ligaments remain for the most part intact, and both ulna and radius are displaced with the epiphysis If operative measures are deemed necessary, the safest and simplest method is to reduce the epiphysis by traction on the forearm and forced flexion, and then to drive a nail through the lateral epicondyle through the epiphysis into the shaft of the bone. The nail will not enter the joint cavity Fractures through the lateral condyle usually start in the groove between the capitulum and the trochlea They pass upward and laterally, severing the capitulum and lateral epicondyle and part of the shaft from the rest of the bone They can be treated by a nail driven obliquely through the lateral epicondyle into the shaft The joint is not entered Fractures through the trochlear surface commence in the deep notch in its centre which receives the wedge-shaped edge of the A simple fissure may start here which passes upward and medially into

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the shaft, separating part of the trochlear surface and medial condyle from the rest of the shaft This can be treated without opening the joint by driving a nail through the medial epicondyle upward and laterally into the shaft T and Y fractures start at the same point in the trochlear surface The line of fracture bifurcates medially and laterally at the upper end of the coronoid and olecranon fossa and passes to the sides of the shaft The result is equivalent to a transverse fracture above the condyles with a vertical fissure into the joint. They can be fixed by nails which need not penetrate into the joint cavity. One nail enters at the lateral epicondyle and passes transversely across the capitulum and trochlear surface Another enters at the lateral epicondyle near the first and passes upward and medially through epicondyle and lower end of the shaft Fractures of the shaft at a higher point than the olecranon fossa are best treated by splitting the triceps vertically in the middle line and plating the bone. In the description of the shaft of the humerus this will be treated more in detail It will be seen that 'the lateral epicondyle is the key to the situation in the treatment of most of these fractures

2 Shaft—The insertion of the deltoid muscle into the lateral aspect of the shaft of the humerus just above the radial groove marks a point in the bone just above its middle. It serves as a convenient landmark to locate fractures of the shaft of the bone. It will be employed in the following description as a convenient point around which to group a number of important anatomical structures

A study of the posterior surface of the humerus (Fig 9, B) shows that the medial head of origin of the triceps is attached to the whole aspect of its lower third, and reaches proximally a point a little above the middle third, medial to the radial groove Lateral to the radial groove from below upward can be seen part of the origin of the brachialis muscle, part of the deltoid insertion and the lateral head of origin of the triceps The upper end of the last-named reaches almost as far as the insertion of the teres minor, which abuts directly on that of The radial groove occupies a very important position on the the infraspinatus posterior surface of the bone. It is very oblique and occupies approximately the In it lie the radial nerve and the arteria profunda middle third of the shaft A line drawn vertically upward along the middle of the posterior surface of the shaft of the humerus would touch the groove at a point near the lower part Near this point also an arterial foramen in the bone is of the deltoid insertion The radial groove contains structures so essential to the found in the groove future well-being of the limb that it should never be interfered with unless the radial nerve has been injured in its course along it. It would therefore appear that the posterior aspect of the shaft in the neighborhood of the groove should be avoided in choosing an operative field Below the groove the bone is covered by the medial head of the triceps, the fibres of which pass into the deep surface of a broad tendon, which is inserted into the olecranon process. Access to this portion of bone is feasible and comparatively easy if the muscle is split vertically line of cleavage is carried upward a little medial to the centre of the posterior surface of the arm the bone can be exposed almost as high as the deltoid inser-The split in the triceps does not appear tion without opening the radial groove to injure the nerve supply to the muscle because the nerves distributed to the medial head pass vertically downward in the muscular fibres parallel to the incision (Fig 10)

The anterior surface of the bone is shown in Fig 9, A

(a) The lower half is covered by the origin of the brachialis muscle from the insertion of the deltoid proximally to the elbow-joint line distally. Proximally the origin of the brachialis forms a V, the arms of which clasp the insertion of the deltoid. The medial portion of this V runs upward almost as high as the upper

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part of the deltoid insertion Medial to it, is the insertion of the coracobrachalis muscle Occupying narrow strips of the lateral aspect of the lower part of this surface are the origins of the brachioradialis proximally and the extensor carpi radialis longus distally Between the brachialis and the two last-named muscles lies the radial nerve Superficial to the brachialis muscle lie the muscular belly of the biceps, the brachial artery with its venæ comites and the median nerve, also the ulnar nerve at its upper part. The artery and nerves are on the medial aspect of the biceps muscle From the artery passes a branch to an arterial This trunk penetrates the upper and inner part of the foramen in the bone The upper end of the brachioradialis marks the position where brachialis muscle the radial nerve pierces the intermuscular septum to get to the front of the arm Superficially, this point may be represented as the junction of the upper and middle thirds of a line drawn from the external epicondyle to the deltoid insertion only accessible part of the anterior surface of the bone is represented by an area on its upper and lateral aspect medial to and below the deltoid insertion surface is covered by the brachialis muscle. This accessible area can be reached by an incision along the lateral aspect of the biceps muscle between it and the deltoid insertion (Figs 11 and 12) The incision can be carried downward as far as safety allows It will expose the insertion of the deltoid and the origin of the brachialis muscle which embraces it. The brachialis can then be split or peeled away from the bone The musculocutaneous nerve will be retracted with the biceps and will be in no The nerve supply to the brachialis (from the musculocutaneous and from the radial) will also be safe. If necessary, the insertion of the deltoid can be peeled from the bone

(b) The upper part of the anterior surface of the humerus (Fig 9, B) shows the intertubercular groove in which rests the long tendon of the biceps. The insertions of the pectoralis major (to the lateral lip), of the latissimus dorsi (to the floor) and the teres major (to the medial lip) can be seen The pectoralis major covers the whole of this area as far as the lateral lip and the groove can only be exposed after the division of its tendon of insertion (Fig. 11) Proximally to the insertion of the teres major, that of the subscapularis into the smaller tubercle can be seen An area on the outer surface of the upper third of the shaft bounded by the deltoid insertion distally, the insertions of the supraspinatus, infraspinatus and teres minor proximally, the lateral lip of the intertubercular groove anteriorly and the lateral head of the triceps posteriorly is free from any muscular attachments covered by the muscular mass of the deltoid. Winding round the upper part of this area just below the tubercles are the nerve (avillary) and the artery (art circumflex post) which supply the deltoid. The part of the bone in contact with these structures is the surgical neck. The nerve and artery come from the axilla by passing through the quadrilateral space A study of Fig 10 will show that an attempt to reach the surgical neck of the humerus by an incision along the posterior border of the deltoid would invite disaster by endangering the nervous and vascular supply to the deltoid. The upper portion of the shaft below the surgical neck is accessible by this route. If care is taken to keep superficial to (i.e., anterior to) the lateral head of the triceps the radial nerve would be avoided It would, however, be a difficult route and should be reserved for special cases of open fracture with the wound in this situation

The best route both for the surgical neck and for the upper portion of the shaft as low down as the insertion of the deltoid is in front. If an incision is made between the pectoralis major and deltoid it can be carried upward and downward as far as may be required. In the lower part of the field the bone can be exposed with ease between the insertion of the deltoid and the medial head of the origin of the

## OPERATIONS ON LONG BONES OF EXTREMITIES

A little more proximally the bone can be exposed lateral to the insertion of the pectoralis major by vigorous lateral traction of the deltoid pectoralis major covers the anterior part of the surgical neck The lateral aspect of the neck may be brought into view by retraction of the deltoid (or, better still, by transverse section of the anterior part of the deltoid near its origin from the clavicle and acromion process) If this is done the nerve supply to the muscle will Ample room is obtained and subsequent suture of the muscle will Figs 11 and 12 show such a division of the deltoid with restore its function thorough exposure of the tubercles and surgical neck of the humerus surgeons prefer to split the deltoid and to approach this aspect of the shaft on its outer aspect This has the grave objection that all the muscular fibres in front of the incision will atrophy

3 Proximal Extremity - The proximal extremity of the humerus consists of the head and the larger and smaller tubercles (Fig 9) Below the tubercles the contracted portion of the shaft is called the surgical neck. The head consists of about one-third of a spheroid It is attached to the posterior medial and upper end of the shaft and the centre of the spheroid points backward and medially covered with articular cartilage Around its margin is a shallow groove well marked above, but smooth with the shaft below. This is known as the anatomical neck and to it the capsule of the joint is attached Lateral to the groove is the prominence of the greater tubercle above, and the lesser tubercle in front tween the tubercles is the intertubercular groove (bicipital) The head and the greater and lesser tubercle form the upper epiphysis which sits on the pointed end of the diaphysis like a cap The epiphyseal line lies within the articulation on the medial aspect of the joint, but well outside the joint on the lateral aspect it is in direct relationship with the intertubercular (bicipital) groove and hence with the joint In cases of separation of the proximal epiphysis the proximal end of the diaphysis is usually displaced laterally and upward and lies under the deltoid The epiphysis is tilted sideways In cases where operation is necessary, muscle the deltoid fibres can be split for a limited space over the outer aspect of the joint just below the tip of the acromion process. If the case is recent, traction on the shaft will draw the upper end of the diaphysis downward A sharp hook should now be placed into the greater tuberosity and by pulling downward the epiphysis can be replaced on the upper end of the shaft. It may be sutured in position by silver wire or kangaroo tendon or nailed to the shaft by a peg In old-standing cases where we are unable to is no risk of opening the joint dislodge the upper end of the diaphysis by traction and where quite a long deltoid incision would be needed to give sufficient room, it would be better to make a vertical cut along the anterior border of the deltoid through which the muscle could be separated from the pectoralis major, and to supplement this by a transverse incision just below the acromioclavicular arch along which the deltoid could be divided and retracted posteriorly and distally, toward its vascular and nervous supply By this means a perfect view of the upper end of the shaft of the humerus. surgical neck and tubercles would be obtained without permanent damage to the Subsequent suture would restore the integrity of the deltoid completely

The region of the intertubercular (bicipital) groove and the lesser tubercle can be exposed by an incision between the deltoid and pectoralis major. The long tendon of the biceps comes into view as it passes downward between the tubercles. The joint can be opened by incising the capsule along the tendon. By rotating the humerus outward the lesser tubercle with the insertion of the subscapularis into it comes clearly into view.

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#### RECAPITULATION

From the foregoing we may safely draw the following conclusions as to the safest methods of exposing the humerus .

- A Shaft—(1) In the lower third, the bone can be reached safely by the posterior route, the deep dissection splitting the triceps muscle parallel to its fibres
- (2) In the middle third, one has choice of two routes (a) the safest is the anterior which passes between the biceps and the insertion of the deltoid in its upper part and along the outer edge of the biceps in its lower part. The bone is exposed medial to the deltoid insertion and laid bare by splitting or peeling off the origin of the brachialis muscle (b). The lower part of this area can be reached from behind by splitting the triceps. The field of operation is, however, limited above by the radial groove which is too near for safety.
- (3) In the *upper third*, the anterior route between the pectoralis major and the deltoid is the best and the safest. The route along the posterior margin of the deltoid endangers the nervous and vascular supply to the muscle too seriously. It should not be forgotten, however, that if due care is exercised the bone *just above* the deltoid insertion can be exposed with comparative safety by dissecting carefully between the posterior edge of the deltoid and the lateral head of the triceps
- B Articular Ends—(1) Lowr articular end The lateral aspects of the condyles can be reached through small incisions directly over their prominent subcutaneous parts. If necessary, the incisions can be carried upward along the external and internal muscular septa and the deep dissection carried to the bone along this plane. The soft parts can be separated from the bones on their anterior and posterior aspects, and sufficient room obtained to treat foci of osteomyelitis, or in the case of fractures to fasten the fragments together with screws or nails. Plating is difficult through such incisions. To apply a plate properly, as may be required in T-fractures, the best route is a posterior vertical incision which splits the triceps muscle near its insertion.
- (2) Upper articular end An incision along the anterior margin of the deltoid gives the best exposure in most cases. If supplemented by a transverse cut backward through the deltoid muscle near its origin, the exposure of the upper articular extremity is so complete that fractures of the anatomical neck and of the tubercles and foci of osteomyelitis can be dealt with in a very satisfactory manner. In uncomplicated cases of fracture of the greater tubercle, a small puncture might be made through the deltoid and a nail driven through the tubercle into the shaft to pin it in place. The head of the nail can be left outside the skin incision to facilitate removal when the bony surfaces have united

### THE LOWER EXTREMITY

THE TIBIA—I Distal Extremity This is roughly quadrangular in shape. The lower surface is covered with cartilage and articulates with the talus. The an-

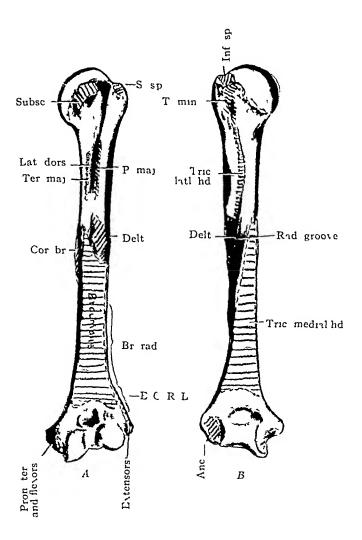


Fig. 9—Anterior (A) and posterior (B) view of the humerus showing muscular attachments. Notice the strategic position of the insertion of the deltoid muscle as an aid to group the anatomical structures. The radial groove is shown in relief in the posterior view.

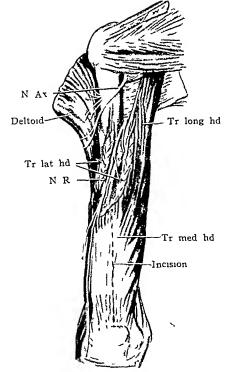


Fig to—Dissection of the muscles on the posterior aspect of the arm. The medial head of the triceps has been left undisturbed. A dotted line running vertically shows the method of exposing the lower third of the shaft of the bone. The radial groove has been opened by dividing the lateral head of the triceps and the radial nerve is exposed. The deltoid muscle has been severed from the acromion process and spine of the scapula and retracted forwards. The nerves supplying the muscle are shown. They are derived from the avillary nerve the triunk of which can be seen passing backwards through the quadrilateral space. Between the lateral head of the triceps and the posterior border of the deltoid near its insertion the shaft of the bone is accessible for a short distance.

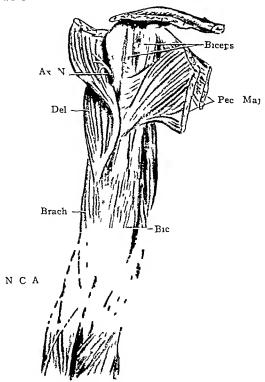


Fig. 11—A dissection of the muscles on the anterior aspect of the arm. The insertion of the pectoralis major has been left intact. Above it the tendons of the long and short heads of the biceps are shown. The deltoid muscle has been detached from the clavicle and acromion and thrown backward exposing the upper end of the shaft of the humerus and the greater tubercle. The axillary nerve is shown. The nervus cutaneus antebrachii lateralis (O. T. musculocutaneous) is shown near the bend of the elbow.

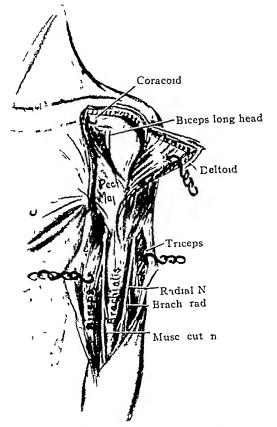


Fig 12—Dissection of the anterior surface of the arm to show the method of access to the upper two thirds of the shaft of the humerus by a safe route. The deltoid muscle has been divided near its clavicular and acromial origin and retracted laterally. The belly of the biceps muscle has been retracted medially. The upper end of the shaft of the humerus and the greater tubercle is exposed. By working between the insertion of the pectoralis major and deltoid still more of the shaft could be exposed, and by splitting the brachialis distally along the same line, the anterior surface of the shaft could be exposed to a low level. With reasonable care there would be no danger of injuring the musculocutaneous or radial nerves (original dissection).

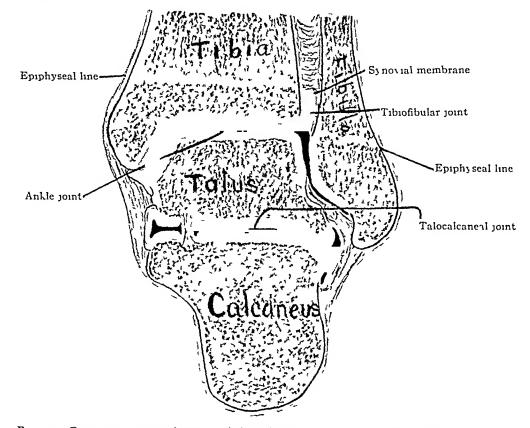


Fig. 13—Represents a coronal section of the ankle-joint. It shows that the epiphysical line of the distal end of the tibia is entirely outside the joint cavity. That of the fibula impinges on the joint on its medial aspect. Note the prolongation of the lower tibiofibular joint almost as high up as the epiphysical line of the tibia.

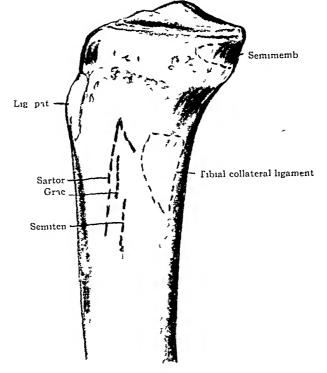


Fig. 14—Represents the medial surface of the proximal end of the tibia. The area between the insertions of the sartorius and the ligamentum patellæ gives access to the upper end of the diaphysis and the epiphyseal line. The medial surface of the shaft below the insertion of the semitendinosus is free from muscular attachments.

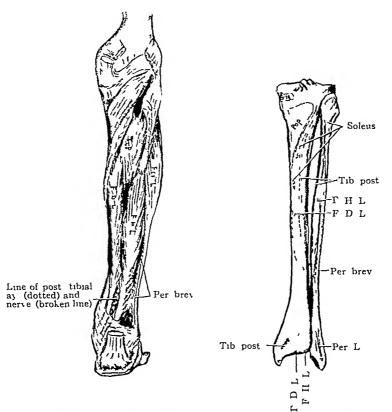


FIG 15—Represents on the right the posterior aspects of the tibia and fibula with the muscular attachments to the bones on the left a dissection of the deep muscles of the posterior aspect of the leg On the bones the large area of the posterior aspect of the lower third of the tibia free from muscular attachments is well shown. At its distal extremity the tendinous grooves are seen. On the posterior aspect of the lateral malleolus the groove for the peronei tendons is seen. The muscular dissection (left) shows by dotted and broken lines the posterior the posterior tibial artery, and the tibial nerve lying between the tendons of the flevor digitorum longus and flexor hallucis longus. It is through this interval that the bone is exposed for tendon implantation.

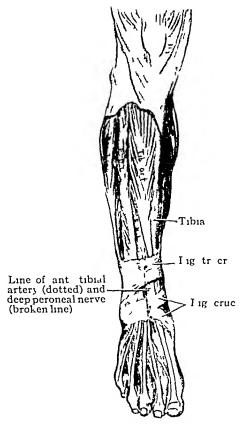


Fig. 16—Represents a dissection of the muscles on the front of the leg. It shows also the subcutaneous portion of the medial surface of the tibia. Just above the ankle joint the tendons are bound down by the ligamentum transversus cruris. Here the lines of the anterior tibial artery and the deep peroneal nerve are represented by dotted and broken lines. The bone (tibia) is exposed by passing between the tendons of the tibialis anterior and the extensor hallucis longus and retracting the tendon of the hallucis to the lateral side.

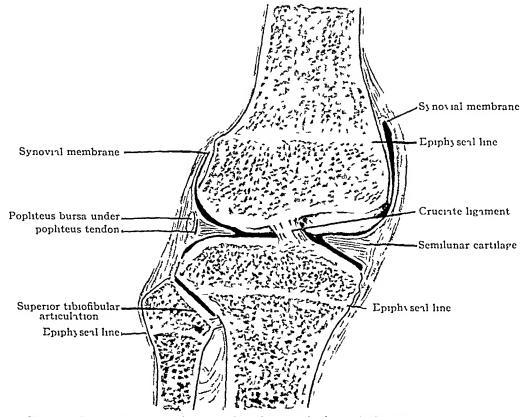


Fig. 17—Represents a coronal section of the femur and tibia and fibula through the knee joint. The epiphyseal line of the tibia is extra-articular as regards the knee-joint. On its lateral side it communicates with the proximal tibiofibular joint. The epiphyseal line of the fibula is extra-articular. The epiphyseal line of the femur is extra-articular on the lateral side on the medial side the reflexion of the synovial membrane passes proximal to it. A study of Fig. 19 will explain this

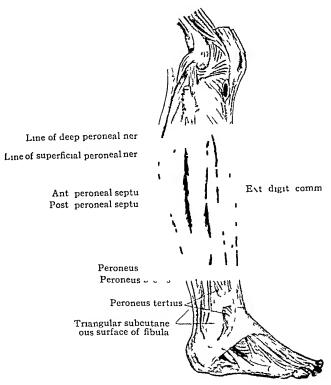


Fig. 18—Represents a dissection of the muscles on the lateral aspect of the leg subcutaneous portion of the fibula at the lower part and above this the peronei muscles covering the lateral surface of the fibula. The anterior and posterior peroneal septa are designated. The lines of the deep peroneal nerve in the substance of the peroneus longus on its way to the front of the leg is shown by the upper oblique dotted line. That of the superficial peroneal nerve (musculocutaneous) in its\_intramuscular course is shown by the lower oblique dotted line.

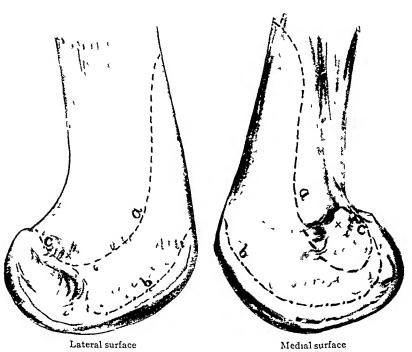


Fig. 19—Represents lateral views of the distal extremity of the right femur. Each epicondyle is shown by a cross. The line of attachment of the synovial membrane to the bone is shown by the dot and dash line b the line of reflevion by the dotted line a. At c the two lines coincide and pass across the posterior aspect of the bone. On the lateral surface distal and posterior to the prominence of the epicondyle a deep groove from which the popliteus takes its origin is clearly snown

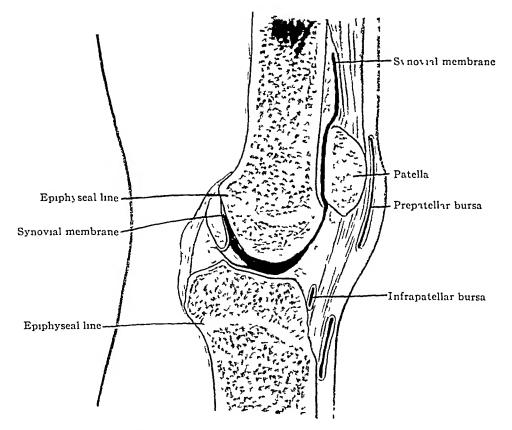


Fig 20—Represents a median sagittal section through the knee-joint. It shows the prolongation of the synovial membrane upward above the patella and the anteroposterior relationships of the epiphyseal line to the knee-joint. In front the line is very close to the attachment of the synovial membrane behind it is a short distance proximal to the joint. The epiphyseal line of the tibra is seen to be far removed from the joint cavity.

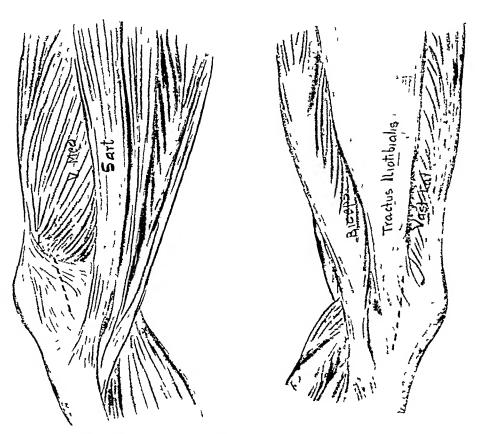


FIG 21—Represents a dissection of the muscles on the medial and lateral aspects of the lower end of the femurand knee-joint. The broken vertical lines show the incisions employed to expose the outer surfaces of the condules and the lower end of the shaft. The lowest point corresponds to each epicondyle Notice the respective levels of the vastus medialis and vastus lateralis. Notice also the solidity and strength of the tractus iliotibialis. (The vertical lines are not quite correct. The upper ends should be more posterior)

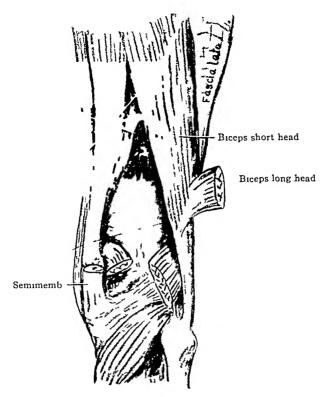


Fig. 22 —Represents a dissection of the deep muscles bounding the popliteal space. It is intended to show the method of access to the posterior surface of the femural ateral to the tendon of the adductor magnus. The adductor opening through which the femoral artery and vein pass is shown by a kite shaped slit.

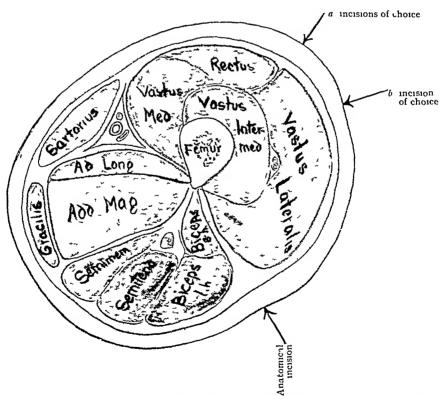


Fig 23—Represents a transverse section of the thigh about the middle of Hunter's canal. The shaft of the femur is seen to be deeply embedded in muscles. The incisions of choice are shown by the arrows marked a and b the former passing between the rectus femoris and the vastus lateralis the latter passing through the substance of the vastus lateralis. In either case the vastus intermedius will be divided before the bone is reached. The anatomical incision is shown by an arrow. It passes in this situation between the vastus lateralis and the short head of the biceps cruris. It is evident that this incision is excellently placed for drainage.

terior surface is covered by the tendons of the tibialis anterior, the extensor pollicis longus and the extensor digitorum communis as they course from the leg to the The anterior ligament of the ankle-joint is attached along a groove just proximal to the articular surface. The posterior surface is covered by the tendons of the flexor pollicis longus, the flexor digitorum longus and the tibialis posterior as they pass to the sole of the foot The last two structures pass in a groove (sulcus malleolaris) which runs along the posterior border of the malleolus (Fig The lateral surface is applied to the fibula over a triangular area to which strong fibres of the interosseous ligament are attached Part of this area is often covered by cartilage and forms a part of the synovial cavity of the ankle-joint (Fig 13) The medial surface is prolonged downward into the medial malleolus, the medial To its apex the strong deltoid ligament is surface of which is subcutaneous Along its posterior border there is a distinct broad oblique groove which accommodates the tendons of the tibialis posterior and the flexor digitorum communis (Fig 15) The epiphyseal line is entirely outside the joint cavity (Fig The medial surface including the malleolus is subcutaneous and accessible It is exposed frequently in open operations for fracture (Pott's fracture, separation of lower epiphysis, etc ) and in cases of osteomyelitis in the neighborhood of the epiphyseal line

2 The Shaft—The medial surface of the shaft of the tibia is subcutaneous from end to end except in its upper fourth, where the tendons of the sartorius, gracilis and semitendinosus overlap it (Fig 14) as they pass to their insertions It is the most accessible surface of the bone and for that reason operations on fractures and inflammatory foci are always conducted from this side osteomyelitis in the upper end of the diaphysis can be reached by an incision placed between the insertions of the sartorius and the ligamentum patellæ peeling the insertions of these tendons from the bone and preserving the periosteum to which they are intimately attached large areas of diseased bone can be removed without jeopardizing the subsequent reproduction of the upper end of the shaft The lower end of this surface passes distally into the medial malleolus which is also subcutaneous The surface of the shaft proximal to the malleolus is frequently exposed in orthopædic operations. In cases of talipes valgus the tendon of the tibialis anterior is exposed, dislocated and fastened into a vertical groove made in the medial surface of the tibia (Galli) In cases of talipes equinus the same surface is pierced with a drill and artificial silk ligaments (Bartow, Bradford) or fascial strips are passed through the drill holes, the other ends being passed through the bones of the tarsus on their dorsal surfaces

The lateral surface of the tibia is bounded in front by the anterior crest (shin) and behind by the interesseous crest From its proximal two-thirds the tibialis It is very deep and inaccessible and is on that account anterior muscle arises In its distal third this surface passes to the front where it is never exposed easily accessible. No muscles arise from its surface, but over it the tendons of the tibialis anterior, the extensor hallucis longus and the extensor digitorum communis pass obliquely on their way to the foot. On it lie also the anterior tibial artery and the deep peroneal nerve The artery and nerve lie in close contact with each other, the nerve being placed laterally Both structures are deeply situated and lie in close contact with the periosteum. The tibialis anterior lies to the medial side of the artery Just above the ankle-joint the artery is crossed superficially from the lateral to the medial side by the tendon of the extensor The extensor digitorum longus lies to the lateral side of the hallucis longus It would be possible to utilize this surface for tendon fixation vessel (Fig 16) in cases of paralytic toe drop in the following manner A vertical incision is made along the lateral border of the tibialis anterior tendon The ligamentum transversum cruris is incised and the extensor tendons exposed The artery and nerve

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will be found lying underneath the extensor hallucis longus. If the tendon of this muscle is retracted to the lateral side, the anterior tibial artery and nerve will be exposed lying on the lower end of the tibia. The artery and nerve can be retracted from side to side while a groove is made in the bone in which the distal ends of the tendons are fixed. Finally, the artery and nerve are put back in place between the tendons. It is found, however, that silk tendons and fascial transplants passed through drill holes in the subcutaneous inner surface of the lower end of the tibia above, and through the tarsal bones below, is a much better operation for toe drop

The posterior surface of the shaft Practically all of the upper three-quarters of this surface is covered by muscles which are attached to it (Fig 15) are the popliteus, soleus, flexor digitorum longus and the tibialis posterior large arterial foramen, along which passes the nutrient artery of the bone, is placed at the junction of upper and middle thirds of the bone in the area covered by the tibialis posterior The popliteal vessels and the tibial nerve lie on the posterior surface of the popliteus muscle as far as its lower border this point (where the popliteal divides into the anterior and posterior tibial branches) the posterior tibial artery and the tibial nerve lie on the posterior surface of the tibialis posterior muscle The nerve hes lateral to the artery imposed on the above-named structures lie the fleshy masses of the gastrocnemius and the soleus and the tendo Achillis It will be evident that this surface of the bone should never be exposed deliberately. The lower quarter of this surface has no muscles arising from it or inserted into it. It is covered completely by the tendons of the tibialis posterior, flexor digitorum longus and the flexor hallucis longus (Fig 15) Between the last two lie the posterior tibial artery and the tibial nerve Both structures lie on the bone and the nerve is lateral to the A short distance above the ankle-joint the tendon of the tibialis posterior slips medially between the tibia and the tendon of the flexor digitorum longus. It then passes downward under the ligamentum laciniatum in a groove on the back of the median malleolus invested in a special synovial sheath Parallel to it and placed laterally in a special synovial sheath courses the flexor digitorum longus Lateral to this in order lie the posterior tibial artery and the tibial nerve Lateral to these structures, enclosed in a special synovial sheath and lying in a special groove in the tibia, lies the tendon of the flexor hallucis longus tendon is deeply situated but can be recognized by the fleshy fibres which enter its lateral aspect almost as low down as the synovial sheath This surface is of great surgical interest, masmuch as it is frequently exposed by surgeons, for the purpose of implanting the distal end of the tendo Achillis into a groove made into the bone. for the relief of paralytic talipes calcaneus. After exposure and division of the tendo Achillis by an incision along its medial border, the deep fascia of the leg is divided medial to the flexor hallucis longus. The posterior tibial artery and nerve are retracted medially and the flexor hallucis longus laterally and the posterior surface of the bone exposed After gouging a groove deep into its medullary cavity the distal end of the divided tendo Achillis is fixed in the cavity and the periosteum closed over it (Galli)

3 The Proximal Extremity—The proximal end consists of the medial and lateral condyles (tuberosities), the intercondyloid eminence (spine), and the tuberosity (tubercle) This practically correponds to the whole upper epiphysis of the bone. The epiphyseal line is entirely extra-articular as regards the knee-joint. On its lateral aspect it passes through the cartilaginous area which forms the tibial part of the proximal tibiofibular joint (Fig. 17). On the medial side it is considerably distal to the knee-joint and reaches the surface of the bone in the substance of the tibial collateral ligament. Anteriorly it curves downward distal to the tubercle of the tibia. Posteriorly it reaches the surface considerably distal

to the attachment of the posterior ligament of the knee-joint (Fig 20) The anterior and medial surfaces of the medial condyle are subcutaneous and accessible. The posterior surface is inaccessible, being occupied by the insertion of the semi-membranous tendon and covered by the tendons of the sartorius, gracilis and semitendinosus. The lateral epicondyle is accessible in front of and proximal to the upper tibiofibular articulation. Behind this the tendon of the biceps and the common peroneal nerve are superficial to it. The tuberosity is accessible at its distal extremity below the attachment of the ligamentum patellæ (Fig 14). Proximally, the ligamentum patellæ covers it and is separated from it by a bursa (Fig 20).

THE FIBULA - I The Distal Extremity - The distal extremity of the fibula, or lateral malleolus, is of a pyramidal shape. It is situated on a plane posterior to and extends further toward the sole of the foot than the medial malleolus (Fig 13) Its lateral surface is subcutaneous and is continuous with a triangular-shaped To the apex of the malleolus and lateral surface on the lower part of the shaft to its anterior border are attached ligaments. Its posterior border shows a deep groove in which the tendons of the peroneus longus and brevis lie surface has a triangular articular area which articulates with the lateral surface of the talus Behind this is a deep depression in which the posterior talofibular ligament is attached. The line of separation between the epiphysis and diaphysis corresponds to the level of the joint between the tibia and the talus municates with the ankle-joint (Fig 13) Above the epiphyseal line the lower end of the diaphysis is in contact with the synovial prolongation of the ankle-joint which lines the lower tibiofibular articulation. The whole of this part of the bone is accessible from its subcutaneous aspect. It is accessible in fractures of the external malleolus, in cases of tuberculous osteomyelitis and rare cases of acute osteomyelitis

2 Shaft—On the lateral surface of the distal extremity of the shaft of the fibula there is a triangular area bounded by two ridges which can be traced above into the anterior crest (Fig. 18) At the apex of this triangle the origins of the peroneous brevis and peroneus tertius diverge from one another This is the most accessible portion of bone and it is quite frequently exposed in the open operative treatment of Pott's fracture This surface passes below into the outer surface of the lateral malleolus The posterior surface of the lateral malleolus is grooved deeply and contains the tendons of the peronei muscles, the longus being most superficial The outer surface of this part of the bone is utilized for tendon fixation in cases of paralytic talipes varus. A deep groove is made in it and the peroneus longus dislocated and fastened firmly in the groove original peroneal groove on the posterior aspect is deepened and the peroneus brevis fixed in it

The rest of the fibula is covered by muscles From the medial surface (the part between the anterior and interosseous crests) arise the extensor digitorum communis, the peroneus tertius and the extensor hallucis longus From the lateral surface (between the anterior and lateral crests) arise the peroneus longus (proximally) and the brevis (distally) muscles From the posterior surface (between the lateral and interosseous crests) arise the soleus muscle (proximally) and the flexor hallucis longus (distally) Dipping down between these three groups of muscles are two strong intermuscular septa, which have firm attachments to their respective crests. The one which passes between the peroneus longus and brevis muscles, behind, and the extensor digitorum communis and peroneus tertius, in front, is called the "anterior peroneal septum". The other which passes between the peroneu in front and the calf muscles (soleus and flexor hallucis longus) behind is called "the posterior peroneal septum" (Fig. 18). The superficial peroneal nerve lies in a sheath in the anterior peroneal septum after it pierces the fibres of the peroneus longus muscle. It becomes cutaneous in the distal third of the leg by piercing

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the deep fascia. There is no structure in the way of approaching the bone along the posterior intermuscular septum which is therefore the route of choice. Blunt dissection behind the peronei will enable us to separate the muscular fibres from the septum until the crest of the bone is reached. In the upper third of the shaft the dissection will pass between the peroneus longus and the soleus. Care must be taken not to injure the deep peroneal nerve as it winds round the neck of the fibula in the substance of the peroneus longus muscle. Roughly, its position is about one inch below the most prominent part of the head of the fibula. In the middle third of the leg the dissection passes between the peroneus longus and the flexor hallucis longus.

3 The Proximal Extremity—The proximal extremity of the fibula consists of the head (capitulum) which joins the shaft by a constricted portion called the neck. The head articulates by an area of triangular shape with the lateral condyle of the tibia. To the apex of the head is attached the short fibular collateral ligament and part of the tendon of the biceps. In front of the head there is a prominent tubercle from which the peroneus longus muscle arises. Behind the head is a tubercle from which the soleus muscle arises. A very narrow area of the bone is accessible between the attachments of these muscles and the attachment of the fibular collateral ligament. To expose the rest of the head and the neck of the bone the muscles attached to it must be elevated and retracted downward. The epiphyseal line is entirely extra-articular as regards the tibiofibular joint and is situated just below the expanded part of the head of the bone (Fig. 17). Great care must be taken in exposing the neck of the fibula not to injure the deep peroneal nerve

THE FEMUR-I The Distal Extremity-By this we mean the epicondyles and The anterior, posterior and inferior surfaces of the medial and lateral condyles are covered with cartilage and lie inside the capsule of the knee-joint The anterior and posterior cruciate ligaments are attached to the intercondyloid fossa, which is a deep space lying between the condules posteriorly (Fig. 17) patella hes in the groove between the condyles in front. It would be impossible to expose the bone from in front or behind without opening the joint cavity lateral aspect of each condyle is subcutaneous and on each there is a projection called the epicondyle (Fig 19, +) The medial projects very prominently is capped by the adductor tubercle and to it are attached the fibres of the tibial collateral ligament of the knee-joint It corresponds to the epiphyseal line lateral epicondyle is not so prominent. Just distal to its most prominent part the popliteus tendon lies in its bony groove, while just posterior to it is attached the fibular collateral ligament The synovial membrane is attached to the femur all around the line of junction of bone and cartilage. The actual joint cavity, however, overlaps the lateral and anterior (Fig 20) aspects of the bone to a large extent and makes it necessary for us to plan an incision outside the line of reflexion of the synovial membrane so as to peel it from its recesses and to uncover the bone The lower surface of the shaft in front is covered by the upper part of the synovial cavity for quite a distance above the level of the upper border of the patella, but the synovial membrane can be peeled from this surface as low down as the cartilaginous margin without opening the joint cavity. Similarly on the lateral aspects of the condyle an area in front of each epicondyle is overlapped by the lateral recesses of the joint cavity. The drawings in Fig. 19 representing the lateral and medial aspects of the condyles show by dotted lines the actual line of attachment of the synovial membrane and its line of reflexion. The line of attachment is shown by the dotted line b, that of reflexion by the dotted line a The line c represents the fusion of a and b

The area proximal to and behind the dotted line showing the line of reflexion of the synovial membrane is absolutely safe for surgical approach. It will be seen that both lateral and medial epicondyles (shown by a cross) are outside

this area, and that there is a considerable area of bone above and behind these prominences, directly accessible A vertical incision extending proximally from the epicondyles could be carried down to bone without risk of opening the knee-joint On the medial side (Fig 21), it would cut through the aponeurotic expansion passing from the vastus medialis to the side of the patella and at a higher level the vastus On the lateral aspect it would split the iliotibial band of fascia medialis muscle itself lata tractus iliotibialis and also at a much higher level sever the fibres of the vastus By peeling the deeper structures from the bone backward and forward a large area could be exposed for operative procedures. In front the reflexion of synovial membrane would be brushed away and there would be no danger of opening This is the route of choice in osteomyelitis of the epiphysis and the articulation In fractures through the condyles and T-fractures, the lower end of the diaphysis nails or screws can be inserted in this area

2 The Shaft—This is so closely and massively invested by muscles that it is only accessible to a slight extent by incisions which pass between the muscular masses

The posterior surface There is a triangular area on the posterior surface of the lower end of the shaft which is bare of muscular attachments (Fig 22) is bounded laterally by the attachment of the short head of the biceps and medially by the part of the adductor magnus descending to the adductor tubercle forms the floor of the popliteal space Resting on this surface are the popliteal artery and vein and the upper geniculate vessels This surface is accessible by a vertical incision along the line of the adductor magnus tendon dissection passes in front of the inner hamstrings which are retracted posteriorly After exposure of the tendon of the adductor magnus, that structure is retracted If the popliteal vessels are retracted laterally a considerable area of The incision is commonly used for ligature of the popliteal bone can be exposed It has been employed by me a few times for the removal of artery (Jobert) sequestra from the lower end of the femur and for the dissection of synovial cysts from the popliteal space In one case of osteomyelitis with a sequestrum partly within and partly without its involucrum, I detached the adductor magnus from the bone over a considerable area, retracting it proximally along with the femoral artery and vein The rest of the posterior surface of the shaft is so closely invested with muscles (adductors, quadratus femoris, glutæus maximus and biceps cruris) over which lie the hamstrings and the great sciatic nerve that it may be considered as inaccessible

The antero-external surface of the femur, by which we mean the surface between the insertions of the adductors (pectineus, adductor longus and brevis and adductor magnus) and the line of origin of the vastus lateralis, is covered by the vasti muscles as by a blanket (Fig 23) The vastus intermedius covers it anteriorly and laterally in its lower three-quarters The same muscle also covers the anterior aspect of the upper quarter The vastus medialis covers the medial aspect of this surface from the spiral intertrochanteric line above as far as the upper border of the medial condyle below The vastus intermedius is overlapped on its medial aspect by the vastus medialis from end to end The free anterior or lateral border of the vastus medialis corresponds to a line running vertically upward along the middle of the front of the thigh The lateral aspect of the vastus intermedius is overlapped by the vastus lateralis over the whole of its lower three-quarters In the upper quarter the intermedius is no longer attached to the lateral aspect of the bone, and here the vastus lateralis invests the bone closely the anterior margins of the vastus medialis and the vastus lateralis the rectus femoris is wedged It lies on the anterior surface of the vastus intermedius the upper two-thirds of the thigh (Fig 24) the rectus can be separated with ease from the vasti muscles Fig 23 represents a transverse section of the thigh

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through the middle of the Hunter's canal and shows the manner in which the It will be seen that the femur cannot be exposed without femur is invested dividing the fibres of the vastus intermedius If the incision passes medial to the rectus femoris (a very undesirable route), it might be possible to separate the rectus femoris and the vastus medialis from one another. If the incision passes lateral to the rectus femoris, that muscle could be separated from the vastus In either case the vastus intermedius would require division lateralis (arrow a) before the bone could be exposed As a matter of fact, the vastus lateralis cannot be separated to any great extent from the rectus femoris except in the lower third The edges of the muscles fuse with one another at the junction of the upper three-fourths with the lower fourth and would require careful separation the level of the middle of the thigh the nerve trunks enter the vastus lateralis and bind it Careful examination of the point of entry of the nerves supplying the vastus lateralis shows that they spread out like the leaves of a fan supplying the middle of the muscle enter it transversely, whereas those passing to the extreme ends are very oblique A lateral vertical incision opposite the middle of the muscle would cut the nerves passing transversely but would not injure those passing obliquely to the upper and lower ends of the muscle middle of the muscle is firmly held in place by its nerves, lesions of the middle third of the bone requiring a long incision would be better dealt with by a laterally placed vertical incision through the vastus lateralis (The line of the incision is shown by the arrow b in Fig 23)

From the foregoing description of the anatomical arrangement of the muscles covering the shaft of the femur, we may conclude that the bone can be exposed safely by the following incisions

- (1) By an incision passing between the contiguous edges of the rectus femoris and the vastus lateralis, along a line drawn from the anterior superior spine to the lateral border of the patella. This route is available from a point just below the middle of the thigh (where the nerves enter the vastus lateralis) to the level of the upper limit of the synovial pouch of the knee-joint. After retraction of these muscles the vastus intermedius would be divided down to the bone (Fig. 23, a)
- (2) By a vertical incision beginning at the lateral epicondyle and extending proximally parallel to the shaft of the bone. The distal fourth or third of the bone could be exposed by this route (see description of the distal end of the femur). Both vastus lateralis and vastus intermedius would be divided (Fig. 21)
- (3) By an incision on the antero-external aspect of the thigh along a line drawn from the middle of the great trochanter to the outer border of the patella This would be applicable to the upper two-thirds or even the upper three-quarters of the thigh In its proximal fourth it would divide fascia lata and vastus lateralis only In its distal half it would divide both vastus lateralis and vastus intermedius (Fig. There is still another, route by which the shaft of the bone can be reaced namely, along the lateral intermuscular septum (arrow C in Fig 23) tion would pass between the vastus lateralis and the short head of the biceps cruris distally, and the vastus lateralis and the insertion of the glutæus maximus proximally It would expose the posterolateral aspect of the bone corresponding to the outer lip of the linea aspera, and its upper and outer and lower and outer branches It is perfectly feasible in the dissecting room, but it has two serious drawbacks from a practical standpoint. First it would entail an incision on the posterior aspect of the thigh which would necessitate giving the anæsthetic in a prone position and would leave a wound difficult of access during convalescence, although placed in a satisfactory position as to drainage Second, it would pass across the course of a number of branches from the perforating arteries on their way transversely across the femur to supply the vastus lateralis next to impossible to avoid injuring these vessels which would be hard to secure

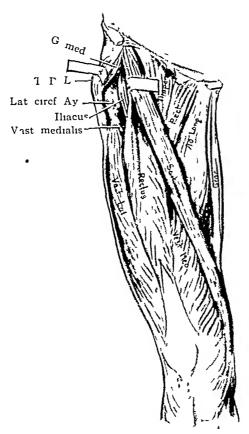


Fig. 24—Represents a dissection of the muscles on the anterior surface of the femur. At the upper end, the dissection has been carried deeply so as to show the steps of an operation to expose the upper end of the femur below the anterior intratrochanteric line and a part of the capsule of the joint distal and lateral to the iliacus muscle. The ascending branch of the lateral circumflex artery is seen crossing the deep part of the wound. The interval between the rectus femoria and vastus lateralis is well shown. The nerve supply to the vastus lateralis enters its medial surface near the edge at the level of the middle of the thigh. The nerves are not shown in the figure (original dissection)

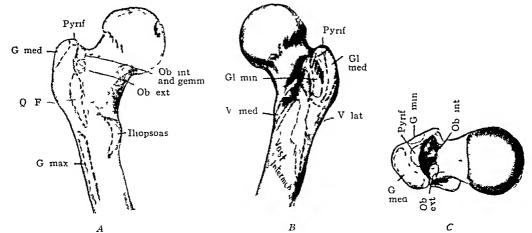


Fig. 25—Represents three views of the proximal end of the femur. A is a posterior view. In it the crista intertrochanterica stands out in relief. B is an anterior view. Note the anterior intertrochanteric line which corresponds to that of the reflexion of the synovial membrane. Also note the clustering of the attachments of the vasti and glutæus minimus on the part of the shaft distal to this line. The area of bone distal and medial to the insertion of the glutæus minimus insertion is exposed in the treatment of osteomy elitis of the upper end of the diaphysis. C is a view of the upper aspect of the head neck and trochanter

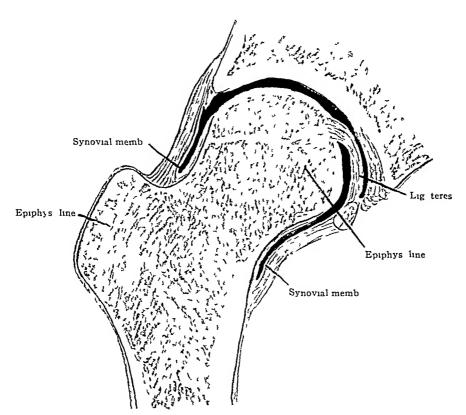


Fig 26—Represents a section through the acetabulum and hip joint. The outline of the joint cavity is clearly shown. The epiphysis of the head is seen to lie entirely within that of the greater trochanter entirely without the joint. The neck of the femur is seen to be continuous with the shaft. The epiphysis of the lesser trochanter is not shown.

3 Proximal Extremity - The proximal extremity of the femur consists of the head, neck and the trochanters The entire head and the greater part of the neck are within the capsule of the hip-joint. The synovial membrane is reflected on to the anterior surface of the neck at the level of the linea intertrochanterica, on the posterior surface of the neck the line of reflection is about midway between the crista intertrochanterica and the margin of the head Thus almost all the anterior surface of the neck is intracapsular but only the proximal half of the posterior The epiphysis of the head rests like a cap on the upper extremity of the It is entirely within the capsule of the hip-joint (Fig. 25) of the great trochanter lies on the upper and outer surface of the shaft. It is entirely extracapsular A third epiphysis is seen in the small trochanter the growth of the shaft the neck of the bone develops in an upward direction, and carrying the head on its apex thrusts itself between the centres of ossification of the great and lesser trochanter A study of the different views of the proximal end of the femur in Fig 26 will show the muscular insertions around the line of the synovial reflexion and attachment of capsular ligament It will be seen that every surface of the head and neck is closely invested by muscles which arise from the pelvis and pass over the joint on the way to their insertions into the trochanters and the contiguous parts of the shaft of the femur

The outer surface of the great trochanter is the most accessible part. It can be exposed by a vertical incision through the strong fascia lata into which the glutæus maximus is inserted. If the fascial edges are retracted the bursa between the glutæus maximus and the side of the trochanter is opened and the whole outer surface of the trochanter exposed. If the vertical incision is carried down to bone it will divide the insertion of the glutæus medius at its upper part and the origin of the vastus lateralis below. By peeling these muscles off the bone the whole outer surface of the trochanter major and the upper part of the shaft can be exposed (Fig. 26, B)

The posterior surface of the neck is so deeply situated as to be practically inacces-A study of the posterior aspect of the bone in Fig 26 A will show that it is covered closely by the pyriformis, both obturators, the gemelli and the quadratus Superficial to these muscles the fleshy mass of the glutæus maximus lies Anatomically it could be exposed by splitting the fibres of the glutæus maximus along the line of an incision passing from the posterior inferior spine of the ileum to the upper part of the trochanter major, and thence downward through the fascia lata for about two inches After retracting the edges of the glutæus maximus the sciatic nerve would come into view as it passed distally over the obturator The pyriformis internus, the gemelli, obturator externus and the quadratus femoris muscle, from under cover of which the sciatic nerve emerges, would serve as a rallying point By retracting this muscle upwards and the gemelli downwards or better still separating them from their insertions and peeling them towards their origins the posterior aspect of the neck of the femur could be exposed The whole procedure is very difficult and the route has little to recommend it The anterior surface of the neck of the femur and that of the trochanter major can be studied in Fig 26 B The glutæus minimus is attached to a large area on the anterior surface of the great trochanter, but as the muscle sweeps from the back to reach its insertion, only a small portion of it lies on the anterior part of the capsule of the hip-joint. The front of the capsule is covered by the iliopsoas, the lateral edge of which (iliacus) lies practically parallel with the anterior intertrochanteric line The contiguous edges of the glutæus minimus and the iliacus are not in contact as often stated. A triangular interval exists between them with its apex at the insertion of the glutæus minimus and its base above and lateral The joint can be opened with safety in this interval by cutting through the anterior part of the capsule along the lateral border of the iliacus. If it is necessary to

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expose the anterior surface of the shaft of the femur below this point the origins of the vastus lateralis, vastus medialis and vastus intermedius can be peeled from the bone. This region can be exposed by an incision from in front, which has been used frequently under various names (Barker's, Lucke's, Hueter's, Anterior incision) for drainage and excision of the hip-joint. It is almost perfect from an anatomical and physiological standpoint. It passes between muscles without dividing them and passes between the muscles supplied by the glutæal nerve (sacral plexus) and those supplied by the femoral (lumbar plexus). It gives by far the most extensive exposure of the diseased area in cases of acute osteomyelitis of the upper end of the shaft of the femur

The steps of the dissection are as follows (Fig 24)

The external incision (the anterior oblique) begins at the anterior superior spine of the ilium and passes downwards and medially parallel with the lateral border of the sartorius muscle The deep fascia is opened between the sartorius and the tensor fasciæ latæ The sartorius is retracted medially and the tensor laterally The rectus femoris now comes into view This is retracted to the medial side The following structures are now exposed At the upper end of the wound the iliacus muscle medially and the glutæus medius laterally. If the glutæus medius be retracted laterally the insertion of the glutæus minimus comes into view tween the minimus and iliacus there is a triangular interval filled with fat. Distal to the insertion of the glutzus minimus lies the upper part of the origin of the vastus lateralis and internal to this the vastus intermedius and medialus (Fig. 26, B) ing the vasti somewhat obliquely is a branch of the lateral circumflex artery often seen as a large trunk which divides at about the level of the base of the trochanter into (I) an ascending branch which passes over the vastus lateralis and enters the borders of the glutæn muscles, and (2) a transverse branch which runs over the vastus intermedius and ends under cover of the vastus lateralis which it supplies The main arterial trunk or its branches should be retracted or ligatured and If the hip-joint is to be opened and explored, the capsule is divided along the lower and lateral border of the iliacus muscle, between it and the glutæus mini-If, on the other hand, the object is to reach the upper end of the shaft and to remove disease from the neck of the femur without opening the hip-joint the origin of the vasti are peeled off the bone to the desired extent and the insertion of the glutæus minimus detached to obtain sufficient room. The dissection in Fig 24 will fully repay careful study

### RECAPITULATION OF ROUTES OF CHOICE

The Tibia—(1) The route of choice is along the line of its subcutaneous surface from the medial tuberosity proximally to the tip of the medial malleolus distally

- (2) Along the line of the medial border of the tendo Achillis and the flexor pollicis longus to expose the posterior surface of the distal end of the shaft for tendon implantation and fixation
- (3) Along the line of the lateral border of the tibialis anterior to expose the anterior surface of the distal end of the shaft for tendon implantation and fixation

The Fibula—(1) Along the line of the subcutaneous surface of the lower fourth of the shaft and the lateral malleolus

(2) Along the posterior peroneal septum for the upper three-quarters of the shaft

The Femur—(1) Vertically upwards from either lateral or medial epicondyle for the lower epiphysis and the lower quarter of the shaft

- (2) An anterolateral incision lateral to the rectus femoris for a small area at the junction of the middle and lower thirds of the shaft
- (3) An external incision for the upper three-quarters of the shaft along a line drawn from the tip of the trochanter major to the outer border of the patella
- (4) Between the vastus lateralis in front and the short head of the biceps cruris and the insertion of the glutæus maximus behind, along a line extending from the posterior border of the great trochanter proximally to the posterior border of the lateral condyle distally (c, Fig 23)
- (5) Along the line of a medial incision extending vertically upwards from the adductor tubercle, to expose the posterior surface of the lower fourth of the shaft (popliteal surface)
- (6) The anterior oblique incision lateral to the line of the upper end of the sartorius muscle for the exposure of the hip-joint, the neck of the femur and the upper part of shaft

# LENGTHENING OF THE TENDO ACHILLIS IN THE TREATMENT OF COMPLICATED POTT'S FRACTURE\*

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Without doubt, the ordinary results from the treatment of Pott's fracture are reasonably good. Occasionally, however, one sees a patient who emerges from his primary treatment with distressing disability. The backward and outward displacement of the tarsus, the separation of the malleoli, and the eversion of the foot, one or all, produce very disturbing loss of function.

Recently, soon after the study of two such cases, the writer was surprised at his inability to maintain correct reposition of the fragments in what seemed to be an ordinary Pott's fracture. The patient, a man of forty, received his treatment, under anæsthesia, only four hours after falling and sustaining a Pott's fracture (Roosevelt Hospital, History A 9649, December 28, 1917). Reduction of the deformity was easy, although there was much swelling, and extreme dorsal flexion was not practicable. The tarsus was pushed well forward and the foot slightly inverted and held at an angle of 90 degrees with the leg. A firmly fitting plaster-of-Paris dressing was then applied

The next day an X-ray picture showed that the reposition had not been maintained, but that the tarsus was displaced backward. It also showed a longitudinal split in the lower end of the tibia with wide separation of the fragments (see Fig. 1)

This longitudinal split in the lower end of the tibia is not mentioned in the ordinary treatises on Pott's fracture, but its existence in this and in the following case show that it is one of the conditions which must be borne in mind. It explained the difficulty in maintaining apposition. The articular surface of the tibia was so shattered that it presented no satisfactory obstacle to the upward and backward displacement of the tarsus under the pull of the calf muscles.

On January 1, anæsthesia was again given in the expectation of lengthening the tendo achillis. However, correct position was easily obtained, and, since the swelling had subsided, it was believed possible to maintain the corrected position by plaster, hence a closely fitting plaster dressing was again applied and the tendon was not then cut

This was an error On the following day the X-ray showed the position worse than ever (see Fig 2). It was manifestly necessary to remove the displacing factor—the pull of the calf muscles. The writer had recently seen the deformity of Pott's fracture reproduced under the tension of the calf muscles while a patient was struggling

<sup>\*</sup>Read before the American Surgical Association, June 7, 1918

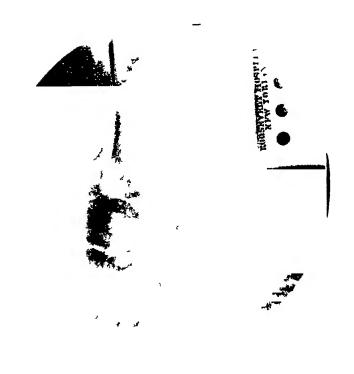


Fig. 1—Comminuted Pott's fracture showing posterior displacement of tarsus after deformity had been reduced under anæsthesia and after a firm plaster of Paris dressing had been applied



 $\Gamma IG = 2 - Comminuted \ Potts \ fracture \ showing \ posterior \ displacement \ of \ tarsus \ after \ seco \ d \ i \ temp^* \ at \ reduction \ under \ ar \ resthesia \ and \ application \ of \ plaster$ 



Fig. 3—Improved position of tarsus after lengthening the tendo achillis and reapplication of plaster

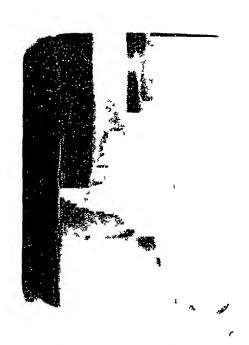


Fig. 4 —Posterior view taken at same time as  $\Gamma$ ig. 3



 $F_{IG} \ \ 5 \ -- Communited \ Pott's \ fracture \ held \ in \ good \ position \ after lengthening of tendo \ achillis \ and \ application \ of \ plaster$ 

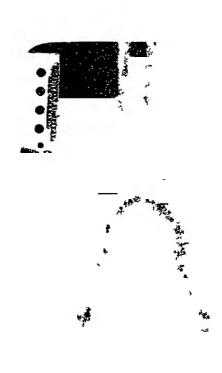


Fig 6 -Posterior view of Fig 5

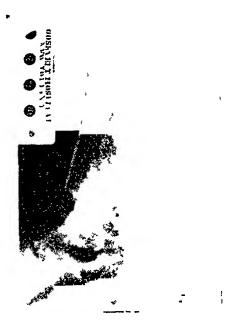


Fig 7 —Same case as Figs 5 and 6 four months later



 $\Gamma$ IG 8 —Same case as Figs 5 6 and 7 four months later (posterior view)

### COMPLICATED POTT'S FRACTURE

in the early stages of anæsthesia. When he was quiet the foot was easily put in correct position, but when he struggled the tension of the calf muscles reproduced the deformity in spite of strong efforts to prevent their doing so. It was a vivid demonstration of the action of these muscles in producing this deformity

The tendon was, therefore, lengthened by the method of Hibbs, and molded plaster splints were applied Dr James M Hitzrot, who was present in consultation, approved the procedure after endeavoring to maintain the position with the knee flexed

The later notes are as follows Patient left the hospital January 24, with foot in excellent position, as shown by inspection and by X-ray (see Figs 3 and 4) He walked with crutches, foot in plaster, weight bearing forbidden

February 15 Plaster removed Position of foot and ankle excellent Still unable to plantar flex foot Slight weight bearing allowed

February 21 Calf muscles beginning to work satisfactorily Tendon shows good formation Position of foot good Slight swelling present

March 4 Good position of foot and ankle Bears weight on foot Calf muscles contracting well Ankle motion 80 to 100 degrees

He improved steadily, resumed his business early in March, using crutches. On June 3, motion in ankle was 80 to 105 degrees. Tendo achillis strong. Calf muscles somewhat atrophied but contracting well and gaining strength steadily. Walks much. Still slight limp. Does not use crutches. The position of foot is excellent. The malleoli seem normal and are the normal distance apart.

A second similar case was seen January 9, 1918 (Roosevelt Hospital, History A 9706) A traffic policeman of very strong build, who fell on the ice and sustained a Pott's fracture. The X-ray showed a longitudinal splitting of the lower end of the tibia (Fig. 5) and his calf muscles were particularly strong, hence the tendo achillis was lengthened at the time of the first anæsthesia and molded plaster applied. The corrected position was maintained as shown by inspection and by X-ray plates (see Figs. 7 and 8). The progress corresponded to the progress of the first case in all essential details. He was put on limited police duty in two and one-half months and gained steadily in strength and in function.

He was seen on May 27th Walked with a very slight limp Motion in foot 75 to 110 degrees. Tendo achillis very strong and well developed. Calf muscles contracting satisfactorily. Conformation of ankle-joint and position of malleoli and of foot seems normal. Firm on his feet and expects to resume his regular duties as traffic policeman before the summer is past.

Habbs 1 has had large experience in the lengthening of the tendo achillis for "muscle-bound feet" He assures a return to normal muscle function

<sup>&</sup>lt;sup>1</sup>Russell A Hibbs N Y Med Jour, July 19, 1902, N Y Med Jour, May 2, 1903, N Y Med Jour, October 24, 1914

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in adults in four to six months "with absolutely no danger of any impairment of the strength of the tendon or the function of the muscle"

I do not find that the procedure has been much used in the treatment of Pott's fracture, but Robert Jones<sup>2</sup> advocates tenotomy of the tendo achillis in those instances where the tarsus is displaced forward and in the equinus deformity which sometimes follows badly healed Pott's fractures

Guichard<sup>3</sup> favorably records the treatment of four cases of Pott's fracture by the aid of tenotomy, in 1902

Manifestly, the procedure is not to be advocated in those instances where proper position of the fragments can be maintained without it, but it certainly should be used in those instances where such position cannot be maintained, especially if there is a longitudinal split of the lower end of the tibia. Also, X-ray pictures should be repeatedly taken to ascertain whether plaster maintains the position and whether a longitudinal split exists

In military surgery the frequent transfer of patients from one surgeon or hospital to another and the fact that so many soldiers are strong and muscular lead one to be particularly careful that bad position is not accepted when good position can so easily be secured by so simple a procedure

The period of treatment does not differ, materially, from the  $4^2/_{10}$  months, which Estes has stated as the term to be expected after fractures of the lower part of the leg

It is also to be remembered that the molded plaster splints of Stimson give more security than a circular plaster encasement

<sup>&</sup>lt;sup>2</sup>Robert Jones Injuries to Joints, p. 174, London, 1917 Notes on Pott's Fracture, Liverpool Medico-Chirurgical Journal, 1887, p. 265

<sup>&</sup>lt;sup>a</sup>Guichard, Ch A These de Paris, 1902, De la Tenotomie du Tendon d'Achille dans les Fractures de Jambes

# RECEIVING AND OPERATING PAVILIONS FOR A MODERN BASE HOSPITAL\*

## By ASTLEY P C ASHHURST

OF PHILADELPHIA

LIEUTENANT COLONEL, MEDICAL CORPS, NATIONAL ARMY, DIRECTOR OF DASE HOSPITAL S4, A E F

It is the purpose of this communication to describe the adaptation of standard barrack buildings to the uses of receiving, bathing, operating, and X-ray pavilions in a Base Hospital. The buildings described form part of Base Hospital 34, American Expeditionary Forces, which is situated in the outskirts of a large city, at a considerable distance from the front

It is believed that the use of barrack buildings for these purposes has distinct advantages even when buildings of permanent construction are available. In the case of Base Hospital 34 there is a large, new, modern building of stone and reinforced concrete, which accommodates in itself 1100 beds. It would have been quite possible to have utilized rooms in this building for receiving, bathing, operating, and X-ray departments, but I believe that no building originally constructed for other than hospital purposes will lend itself so admirably as do these barrack buildings to the purposes indicated, since only the four outer walls limit the arrangement of the interior.

The barrack buildings employed at Base Hospital 34 are of what is known as the Fender type, from the name of the manufacturer. The "life" of those buildings is said to be from three to seven years, without noteworthy repairs. They are composed of uniform wooden panels, each two metres in width and two and a half metres high, made of two thicknesses of wood, with an intervening air space of 75 cm. Each panel, technically speaking, includes the opposite sides of the oblong rectangular building, with the corresponding sections of roof and floor. The roof also is of two layers of wood, separated by an air space, and is covered on the outside with tarred paper. It rises to a peak four metres high and is ventilated about half-way up the slant.

The buildings may be made of any desired length, but are all of uniform width of six metres. Those in use for various purposes at Base Hospital 34 vary from one, which is only 6 panels long (baths for enlisted personnel), up to a number which are 23 panels in length (about 150 feet). These latter serve as wards, with accommodations each for 50 beds

The rapidity of construction is remarkable. The panels fit together with surprising accuracy, and are fastened by bolts. The enlisted men of the Medical Department, attached to our Hospital, learned the mechanism from the French within a very short time, and succeeded in erecting several

<sup>\*</sup>Recommended for publication by the Chief Surgeon, American Expeditionary Forces

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15-panel barracks in an average time of one and a half to two days each This, however, does not include the time necessary to prepare piers for the floors, which may demand two or three days preliminary work. The piers are made just high enough to bring the buildings level, and their use thus does away with the necessity of grading the ground. If cement floors are employed grading is necessary, and there is also the delay required for the cement to set. But if all the materials are at hand, it should not require more than two weeks to construct one of these pavilions.

The four barrack buildings about to be described are placed in a large level courtyard formed by the three wings of the central building of Base Hospital 34. They are of uniform dimensions—6 by 30 metres. The building nearest the entrance road is the Receiving Ward, adjoining this, and connected with it by a covered passage, is the Bathing Pavilion Parallel with these, but 6 metres distant, is the Operating Pavilion, while close to this (3 metres distant) is placed the pavilion devoted to X-ray Laboratories and to dressing rooms for surgeons and for nurses, and a room for the manufacture of surgical dressings. The relations of these buildings are shown in the accompanying plot plan (Fig. 1)

The floor of the Receiving Pavilion is of wood, that of the other three buildings is of cement, which is relatively abundant in France, and which certainly makes much more suitable flooring for bathing and operating rooms than does wood. All four buildings are heated from the central plant (hot water)

As designed by the manufacturers, each alternate panel contains a large window, the intervening panels having small windows placed 275 metres from the floor. But as the panels are interchangeable, it was possible in constructing the Operating Pavilion to place all the large windows on the same side, while beneath the small high windows thus coming to occupy the opposite side of the building, all plumbing fixtures were conveniently located. A similar arrangement in the Bathing Pavilion afforded accommodations along the rear wall for a row of shower baths. The floors of the Bathing and Operating Pavilions are constructed with a broad shallow gutter along one side, thus facilitating cleaning and drainage. Owing to the solidity of the floors it was possible to construct all partitions of tile and plaster. The interior of the buildings is painted, that of the Operating Pavilion being tinted a very pale green. This, with four skylights, gives ample daylight. Artificial light is electric, and gas has been introduced for emergency use

Admission of Patients—The incoming ambulances drive up from the east side, and back against the obliquely placed platforms to discharge their loads. By being placed thus obliquely in the road, a clear passage-way is left for other traffic beyond the ambulances, and the ambulances are enabled to continue on their journey westward, after discharge, without the additional backing manœuvres which would be required if the ambulance bodies were stationed at right angles with the road when discharging

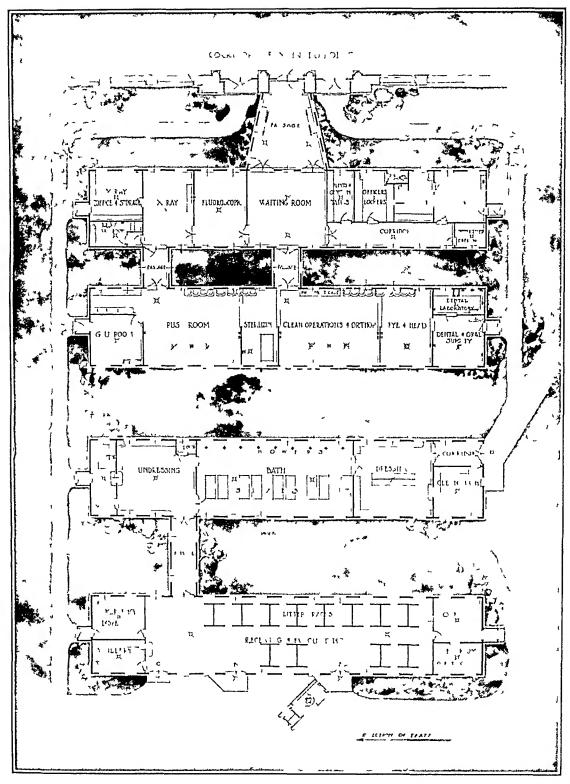


Fig i — Court Buildings, Base Hospital 34 U S A, American Expeditionary Forces (Scale, i centimetre = i metre)

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The patients on litters are carried, and ambulatory patients walk directly into the receiving ward, through doors A and B, where the litters are placed on racks. The litter bearers at once rejoin their ambulances, passing out by door C and carrying with them fresh litters. Attached to the receiving ward are the office of the officer of the day, as well as his bedroom, at the other end of the ward is a scullery, from which hot coffee may be served, and a minor operating room, in which patients may be catheterized, their dressings temporarily re-arranged, and intravenous saline infusions administered. The following regulations are in force

"A waterproof tag will be attached to the wrist or neck of every patient as soon as he enters the receiving ward. On this tag will be noted the patient's name, the tentative diagnosis, and the ward to which he is assigned. After these data have been thus attached to the patient, the diagnosis tags which accompany him from his last station will be removed and from them will be made the necessary records (Forms 52, 55a, and 71, MMD)

"After such emergency treatment as required (scullery and minor operating room), the patient will be removed to the bathing pavilion by attendants coming thence

"In the undressing room he will be completely unclothed, only such surgical dressings as are indispensable and the patient's waterproof tag will be retained. His soiled clothes will be listed in duplicate (Form 75, MMD), will be tied loosely in a bundle, the bundle will be tagged (Form 76, MMD), and it will be passed through the window into the disinfecting room. After disinfection they will be turned over to the non-commissioned officer in charge of the storeroom for patients' effects

"The naked patient will be carried by attendants from the undressing room into the bath room. Patients who can walk may take shower baths. Other patients will be placed on the washing slabs, where they will be thoroughly cleansed with soap and hot water. The hair of the head of all patients, and that of their bodies when necessary, will be closely cropped or shaved. After being dried helpless patients will be carried into the dressing room by clean attendants from that room. The bath attendants will carry patients neither into nor out of the bath room.

"In the dressing room the patients will be given hospital bed clothing, and will be carried to the proper ward by ward attendants. On leaving the dressing room the non-commissioned officer from the receiving ward will see that Form 55a (the "Clinical Brief" of the history) is attached to the proper patient, using the waterproof tag for identification"

The clothing of incoming patients is disinfected in a steam sterilizer, adjacent to the undressing room in the bathing pavilion. The washing of the patients is much facilitated by the use of slabs instead of bathtubs, though one tub is provided. These slabs are of slate, draining to a deep gutter on all sides, and the gutter draining at the foot of the table, the frame of which is constructed of iron piping. It is only when they are placed on the washing slabs that the patients are first moved from the litters on which they have been transported. The soiled litters are cleaned, and are carried back into the receiving ward when the attendants in the undressing room make one of their trips into that ward for other patients.

The Operating and X-ray Pavilions—These are only three metres apart, and being joined by two wide passages form almost one continuous building. They are approached through a wide covered passage-way leading from

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a recovery room in the centre of the main building. Opening out of this recovery room are two surgical wards, with accommodations for 75 beds, while a barrack ward of 50 bed capacity is accessible only three metres distant on the other side of the main building. Thus there are available, on the ground level, 125 beds for patients recently subjected to operation, where they may be kept until it is safe for them to be removed to more distant wards

In the X-ray department are fluoroscopic and radiographic rooms, an office, and the darkroom These rooms connect by a short wide passage with the operating rooms

The other end of this X-ray pavilion is devoted to dressing rooms for surgeons and nurses, and a room for the preparation of dressings for sterilization. As the dressings come to us already made, through the intermediary of the Red Cross, it is necessary for our nurses only to sort the ready-made dressings into packages suitable for sterilization. Until they are needed for sterilization the dressings are stored in a closet next the nurses' work room. There is also a large closet for storage of blankets, splints, oxygen tanks, plaster of Paris, etc.

There are several well-lighted rooms available for purposes of anesthetizing patients this may be done in the wide passage-way leading from the recovery room to the waiting room, in the waiting room itself (when not otherwise occupied), in the corridor to the east of the waiting room, or in one of the operating alcoves not in actual use

In the operating pavilion proper there are accommodations for seven simultaneous operations—a limit which is not likely to be often exceeded Specifically there are accommodations for oral surgery, including dental operations, with a well-appointed dental laboratory for manufacture of prostheses immediately adjacent, an alcove for head surgery in general, including also the eye, ear, nose, and throat, an alcove to accommodate two tables for orthopedic and other aseptic operations, another accommodating two tables for septic cases and a room for genito-urinary surgery. The steam sterilizing apparatus is placed near the centre of the pavilion, and ample accommodations are provided for storing sterile dressings near at hand

In planning this operating pavilion it was determined to attempt a happy medium between the grand saloon type of operating room, where there are no partitions whatever, and the type where each operating table has its special room. The latter plan lacks economy in administration, many more attendants are required, and time and labor is lost by walking around so many corners instead of going directly to the place desired. The former plan, where numerous operators work simultaneously in the same large room, does not always tend to quiet and discipline, and injurious draughts may arise. By employing partitions 3 metres long (which reach half across a barrack building of this type), it was possible to form alcoves of sufficient depth to afford relative isolation for the operating teams, and by arranging that the two alcoves in most constant use should each be of sufficient size to accommodate two tables when necessary, it became possible

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to reduce to the minimum the number of attendants required, as one sterile-handed nurse may easily conduct a suture table for two simultaneous operations

My thanks are due to many members of our professional staff for suggestions of value in connection with the construction of these buildings, and especially to the Chief Engineer Officer, Major Fowler, for procuring material and giving us opportunity to use it as we deemed best I have also to express indebtedness to Corporal Hoke and Private Stern, for their architectural knowledge and for drawing numerous plans

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## THE TREATMENT OF MALIGNANT PERITONITIS OF OVARIAN ORIGIN\*

By Ernest A Codman, M D of Boston, Mass

An exceptionally fortunate series of cases of the kind implied in the above title has attracted me to this subject. I trust that the observations I have made are of importance enough to report to this Society. I may be able to stimulate your interest in looking up the end results in similar cases, and I may be able to give you hope for the hopeless

All surgeons of experience know the type of case I mean we find a large abdominal tumor, usually obscured by ascites and distention, and probably not more accurately diagnosed than as a case for exploratory laparotomy On opening the abdomen there is a gush of straw-colored or blood-stained fluid. An irregular cystic mass adherent to the intestines and pelvic structures, and obscuring the accustomed landmarks, is found Further exploration shows metastases in the omentum and peritoneum the operator is of a radical disposition he breaks down the adhesions, reams out cystic and solid masses of tissue, makes a bloody and disgusting mess and backs out, knowing that he has left portions of the tumor Experienced surgeons probably back out sooner The pathologist reports "cancer," and confuses us with his favorite nomenclature of ovarian tumors send sad messages to the friends, and feel some sympathy for the attending practitioner who must see the patient through the terminal stages of the disease

My hobby for looking up end results has led me to some pleasant surprises in this type of case, for I find 5 cases still alive after periods of sixteen, eight, three, two, and one year respectively. Nature has been in the main responsible for these miracles, but I believe that certain principles of treatment have helped

This is not an essay on the pathology of ovarian tumors. I simply speak of the clinical picture which we all know, whether the type be papillary, colloid or true adenocarcinoma. If you wish a pathologic classification, the best I know is that of Gebhard. From the literature we learn that the colloid form is less malignant than the papillary form and the latter is less malignant than the true adenocarcinoma. In searching the literature it is easy to find references to "the well-known fact" that papillary peritoneal metastases may disappear, but I have been unable to find definite reports of such cases, nor even the original authority for the statement Bland-Sutton says. "It has been clearly established that when the abdomen has been opened for the removal of a papillomatous cyst, the peritoneum has been found studded with warts. A few years later the abdomen has been opened and all the peritoneal warts have disappeared."

<sup>\*</sup>Read before the American Surgical Association, June 8, 1918

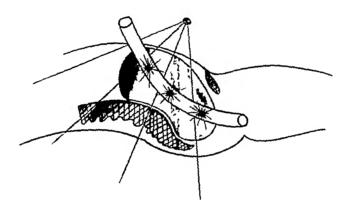


Fig i —Perforated drainage tube to allow (1) repeated introduction of radium, (2) drainage of poisonous by-products (cachexia), (3) direction of least resistance for the pressure incident to growth, (4) lymph to go out through the tumor instead of back into the system, (5) the periphery of the tumor to constantly approach the radium

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But neither Bland-Sutton nor the other authorities give satisfactory instances, and none, with the possible exception of Hofmeier (mentioned by Pfannensteil), give any report of the disappearance or retrogression of true adenocarcinoma

The following five cases which have come under my personal observation seem to me worth reporting, as the pathologic specimens are all preserved in the laboratory of the Massachusetts General Hospital

Case I—E S Records, vol 372, p 76 A woman of thirty-two was operated on by my chief, Dr F B Harrington, at the Massachusetts General Hospital on June 30, 1900 Under the diagnosis of pelvic abscess an incision was made in the vagina, some papillocystic material was curetted out and drainage established Nine days later, at Doctor Harrington's suggestion, I opened the abdomen and found a large inoperable pelvic mass, and diffuse wart-like metastases scattered over the whole peritoneum

From year to year this patient returned to the hospital seeking radical operation and was considered hopeless by the various surgeons to whose services she was admitted. The vaginal sinus persisted and discharged pus and occasionally lumps of necrotic malignant tissue. Although the tumor grew, her general condition improved

Finally, on December 22, 1910, ten years after the original operation, I was persuaded to attempt another. To my surprise, on opening the abdomen, I found the peritoneum perfectly free from metastases and the growth limited to the huge pelvic tumor which was adherent to the neighboring structures. After a sort of nightmare operation, I succeeded in removing the entire tumor with all the pelvic organs, including the rectum. An artificial anus was made. After a tedious convalescence the patient recovered, and when last seen on August 14, 1916, was fat and well—six years after the second operation and sixteen after the first

All pathologic specimens showed typical papillary cystadenoma. The large tumor was more solid than cystic

CASE II—E S Records, vol 664, p 327 A negress, aged twenty-three, was operated on by me at the Massachusetts General Hospital on December 9, 1909 An inoperable pelvic tumor and numerous peritoneal metastases were found A specimen was taken from the peritoneum and reported to be adenocarcinoma. No attempt was made to remove the tumor. She made a good recovery, and in June, 1916, her physician reported that she was well and had since married. A small pelvic tumor still existed—six and one-half years after the first operation.

On May 27, 1918, her physician, Dr C P McClendon, of New Rochelle, N Y, wrote "I have just returned home and found your letter making inquiry about R M I am happy to state that she is in very good health And the trouble of which she complained when I last wrote to you seems to have subsided She seems to be in excellent health. She is sometimes troubled with periods coming on twice a

month, but seldom complains of the sharp pains as she used to She is not willing to be operated and so I just look her over at odd times"

CASE III —Codman Hospital Case 270 July 22, 1915 Female, aged sixty-two years An abdominal tumor larger than full-term uterus Pre-operative diagnosis—ruptured papillomatous cyst of

ovary

*Operation* (E A C and A R Barrow) —Large multilocular cyst It had been ruptured to some extent, and the jelly-like contents had spread about abdominal cavity and in places had become encysted again. The tumor was removed and was found to consist of numberless spaces filled with colloid material, but there were no papillomata—only thin walls. Nevertheless, on section, Dr. J. H. Wright considered the specimen colloid cancer.

Complications -None

May, 1918 Her physician reports by telephone that there is no sign of recurrence

Case IV—Codman Hospital Case No 308 March 13, 1916 Female, aged fifty-five years Abdominal tumor extending from pelvis 2 inches above umbilicus Pre-operative diagnosis—fibroma of uterus, or cystoma of ovary

Operation (E Å C and A R Barrow) —Tumor proved an extensive malignant mass involving all pelvic organs and invading peritoneum with little tubercles Piece of peritoneum excised and reported adenocarcinoma (psammoma) by Doctor Wright Condition considered inoperable and abdomen closed

On reflecting on this case, it occurred to me that as the tumor was evidently partly cystic, it might be possible to obtain through-and-through drainage, and to treat the tumor with radium from inside out, through the pathway thus obtained The patient's relatives were, therefore, sent to consult Dr H A Kelly of Baltimore, Dr John G Clark of Philadelphia, Dr Francis D Donaghue, and Dr R B Greenough of Boston, to see whether such an operation would be justifiable, and it was advised that the attempt should be made, although no precedent existed

On March 22, I operated again and carried a large rubber tube through the mass from the abdomen out through the vagina By introducing radium (obtained through the courtesy of the Huntingdon Hospital) through this tube, a thorough course of treatment was given

To my great astonishment the bulk of the tumor vanished, so that at the time of her discharge on July 29th, there was only a small pelvic mass left. From being almost moribund, her condition had become one of almost perfect health

After this she received several external radium treatments at the Huntington Hospital (No 16,148) which were unfortunately followed by a severe burn of the abdominal wall, from which she suffered a great deal

On March 21, 1917, she re-entered for treatment of the radium burns, which proved so intractable that I decided to excise them At this time her general condition was excellent, and the only remains of the original tumor was an irregular pelvic mass occupying about half the pelvis

Operation (April 10, 1917) (E A C and G A Leland, Jr) — The burns were excised and the abdomen opened The pelvic mass seemed operable, and after a five-hour operation, I succeeded in removing it with the uterus and adnexa To my great surprise the peritoneum now showed no trace of disease, and the uterus and its adnexa, which previously were indistinguishable in the cancerous mass, were now plainly recognizable, although adherent The disease seemed wholly confined to the ovaries, which measured  $7\frac{1}{2} \times 6\frac{1}{2} \times 4$  cm and  $8 \times 6\frac{1}{2} \times 5$  cm, respectively Vaginal drainage was established, and the abdominal wound was closed The appendix, which contained a concretion, was not removed Microscopic examination showed that the ovarian tumors resembled the original tumor, but the cells showed no mitoses In the abdominal scar a few small areas of disease were also found

Complications —An abscess in the abdominal fat and a very small rectovaginal fistula

Result (May 15, 1918) —The patient is well and has gained much flesh. There is no evidence of recurrence. She still has some trouble with a second small radium burn which appeared six months after the last radium treatment.

It is interesting to note also that a small pedunculated fibroid tumor which was present at the first operation was removed at the last operation. It showed no apparent change in size, in spite of the energetic radium treatment

I attribute the favorable outcome in this case to the following factors

- I The tumor could be treated from within outward
- 2 The calcareous deposits by the cancer cells indicated that there was a tendency towards replacement of cancer tissue with lime salts
  - 3 The calcareous atoms could set up secondary radiation
  - 4 The toxic products of destruction could be drained away
- 5 The patient had already shown that she could develop a very large malignant tumor without producing general cachexia
  - 6 The patient herself showed indomitable optimism and courage

CASE V — Codman Hospital Case No 408 Female, aged sixty-three years An abdominal tumor the size of a six months' uterus

Operation (August 28, 1917) (E A C and H V Andrews) — Free brownish peritoneal fluid. Tumor mass adherent in pelvis, partly cystic and partly solid. Peritoneal metastases—some even as high as right renohepatic region. Cysts evacuated and partitions broken down so that rubber tubes could be placed for the use of radium. Both ovaries probably involved.

Post-operative treatment with radium as in Case IV

May 31, 1918 Patient is well and strong, although an irregular pelvic tumor is still present with sinuses through which radium treatment is occasionally given

The section shows papillary adenocystoma of the usual type

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Although this patient has been only nine months since the operation, I consider her progress excellent and plan to do the second operation in a few months, hoping to find, as in the other cases, that the peritoneal involvement has disappeared

Note—Since reading this paper I have again operated on Case V As in Case I and Case IV the effect of drainage (and perhaps also of the radium) had been to localize the tumor and to render it operable As in the other cases I removed the tumor en masse with the uterus and adnexa—Like the specimens in these cases, this one also showed that the mass had shrunk and become solid

Unfortunately in this case the peritoneal metastases had not wholly disappeared, although on the right side of the abdomen they had greatly diminished in quantity. Deep in the pelvis they had apparently increased and were present in the muscular coats of the rectum and sigmoid. Nevertheless I believe these were local implantation metastases and that after removal of the main mass and continued radium treatment there is a real hope that they may disappear. In spite of this difficult operation the patient had a rapid convalescence

The progress of this case, which was treated on a definite plan, seems to me most encouraging, when one contrasts it with the probable outcome of cases treated without drainage as shown by the thirty-nine cases mentioned in the text

In order to have some idea of what the usual outcome of such cases is, I determined to try to trace all similar cases which had been operated on at the Massachusetts General Hospital in the last twenty-five years. This privilege was granted me by the gracious consent of my former colleagues at that hospital. I found 41, excluding all cases which died in the hospital after operation, and all cases in which the records did not give what I considered adequate proof of the existence of a malignant or papillary peritonitis at the time of operation, and also my own cases. I succeeded in tracing all (This speaks pretty well for the records of the Massachusetts General Hospital, I think)

All but two of these 41 cases died of the disease These two were of the colloid type—one living at least nine years and the other over four years One of the colloid cases is worth recording

Massachusetts General Hospital E S Records, vol 546, p 165 Operation by R B Greenough, August 20, 1906 The peritoneal cavity was filled with greenish jelly-like substance A large multilocular cyst was removed and a hernia, following a previous laparotomy, was repaired Several small cysts filled with jelly-like substance were found in the scar tissue. The pathologic specimen showed the characteristic appearance of colloid carcinoma even in the abdominal scar. The abdomen was washed out with weak soda solution as thoroughly as possible. Patient had an uneventful convalescence.

January 22, 1907, she re-entered the hospital, stating that she had been comfortable until four days before, when pain, suggestive of gall-

### MALIGNANT PERITONITIS OF OVARIAN ORIGIN

stones, occurred There was a mass the size of an orange in the right hypochondrium which was exceedingly tender. She was operated on by Dr F B Harrington who found the "peritoneal cavity largely obliterated by adhesions and soft gelatinous tissue, liver completely hidden by these adhesions. Gall-bladder not found and search not persisted in Bit of omentum and gelatinous tissue removed for pathologist" (reported inflammatory)

Patient had complete relief from her pain and normal convalescence She again entered the hospital on December 11, 1915, having in the meantime been operated on at the Boston City Hospital, under a diagnosis of intestinal obstruction. We were informed that at the laparotomy dense adhesions were found about the liver and gall-bladder could not be located.

She now complained that for the last month she had had attacks characteristic of gall-stones and again had tenderness in the right upper quadrant. On December 18, 1915, Dr. D. F. Jones operated and found dense adhesions, but there was no mention in the report of gelatinous material. Some small stones were removed from the gall-bladder. She had a normal convalescence

On January 7, 1917, she reported as being partially relieved

I have been told by Dr R B Greenough that she has recently had another operation for ventral hernia

It seems to me that this case shows evidence that the presence of colloid material, such as found at the second operation, does not necessarily mean hopelessness. Unfortunately, the bit of omentum excised was not a satisfactory proof of the existence of epithelial cells at that date

The others died at the following periods Of the total, 39, 12 died in less than two months after operation, 19 died in less than six months after operation, 29 died in less than one year after operation, 33 died in less than two years after operation, 39 died in less than four years after operation. In other words, 30 per cent died in less than two months and 74 per cent in less than a year. These are rough figures but are conservative. They show that as a rule the condition is rapidly fatal

We may conclude from this that such cases usually die within a year after coming to operation. All of the 41 were operated by competent surgeons, most of them members of this Society. However, my own five cases seem to show beyond doubt that the peritoneum has the power to kill and replace cancer cells under certain conditions. The observations made in these cases have led me to indulge in some speculations in regard to cancer in general, which may be of interest to you

How does cancer kill? In a general way (1) by erosion, as in the case of a rodent ulcer which actually eats its way into a vital structure. This is rare. How few cases any one of you can actually recall! (2) By perforation of a vital structure, as of the stomach or intestine. This is more common but still rare. A preperforative sealing process usually prevents it. (3) By stricture of some vital organ, as in the case of obstruction of the intes-

tine Even this is amenable to timely surgery (4) By mere bulk causing pressure on some vital structure, as in the case of extensive disease of the lungs (5) By cachexia. This you will admit is the common cause, and usually the precursor of the other causes. To be sure, occasionally one sees a case die from erosion of a great vessel, from the perforation of a viscus from occlusion of the intestine of ureters, or from intracerebral pressure, before any cachexia has appeared, but you must agree that in the vast majority of cases there is also a severe cachexia present. And will you not agree also that if we could prevent cachexia, we could prolong many lives indefinitely, and also cope fairly well with these other more mechanical conditions of erosion, obstruction, perforation and pressure, which we handle after a fashion as it is?

What makes metastases? It is a platitude to remind you that cancer tends to grow If the growth is under pressure in the interior of the body, is it not more likely to metastasize than if it is external? External cancers may last for years and give rise to no cachexia whatever The two most benign forms of cancer are rodent ulcer and papilloma In the one case the cells soon lose their vitality when exposed to the air and are wiped off by any light friction In the other they grow outward in grape-like clusters, but in neither case do they cause cachexia or metastases, until their base has invaded the subsoil In other words, the poison which would be absorbed by an internal growth is drained off and the internal pressure of the growth goes outward, sloughing off in the rodent ulcer, and hanging free in papilloma Observe that papilloma is a typical growth in the hollow viscera—of the bladder, of the intestine and sometimes of the stomach Histologically it is hard to tell whether it is benign or malignant in a given case answer in each case could be given if we knew the direction of lower mechanical pressure in the deepest cell This would determine whether the next cell would be cast off into the outer world or into the lymph- or bloodstream If the latter, it would mean danger of metastases and cachevia the former, it would mean freedom from absorption of the poison or spread of the disease

Now how about the ovary? Here we have papillary cystadenoma as the type tumor Cysts develop with papilloma in them. The growth is hardly external or internal. Though inclosed, the direction of least resistance is toward the peritoneal cavity. Cysts form faster than their papillomatous contents. While this goes on they are benign. When the solid cellular part gets the upper hand they become malignant. When the growth of a papillary cystadenoma adding cell by cell reaches a certain point of tension from internal pressure, some cells are forced through the fibrous envelop and protrude on the peritoneal surface. As these little tumors add more cells, their terminal ones drop into the free peritoneal cavity, lodge and take superficial root. They become peritoneal metastases. Sometimes this process is rapid, because some external trauma ruptures the cyst and the cells are seeded through the whole peritoneum.

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In other cases the peritoneal metastases are rather of the nature of direct extension of tumor cells along the peritoneal lymphatics, and are seen as minute whitish tubercles radiating from the pelvic peritoneum upward. Such cases are true adenocarcinoma if I may judge by Cases II and IV. In others, colloid spaces are found in the meshes of the omentum or smoothed into the interspaces of the intestines. But in all of these three kinds the peritoneum indubitably may triumph

We know the wonderful power the peritoneum has in dealing with sepsis and with tuberculosis. Who has not marvelled at seeing the smooth shining surface of the peritoneum, in some case, at a second operation, which a few weeks earlier he saw red and turgid with an angry inflammation? And the return to normal after severe tuberculous involvement is now almost expected. I believe that you may also look for such results in a small proportion of your malignant cases. If my experience has met so many, surely the fact must be that other such happy results are occurring at other clinics, if the cases be followed up

Is my own lucky experience due to my treatment in any way? Case I made me feel that drainage was perhaps the cause. It suggested that furnishing a direction of least resistance and permitting free drainage might prevent metastases and cachexia. Case II showed the tendency of nature in exceptional cases to do much unaided. Case III showed the value of hope when artificial drainage, nature and radium were united to do their best with one object in view. Surgery acted a subordinate part in two cases (I and III) by removing what the other agents had localized. Case V is bearing out my theories. She has no cachexia

Fig I is offered to show you in a glance how my present ideas of the proper treatment are summarized

In conclusion let me set down these facts and principles, for I believe the observations made in these cases justify them

- Facts—I The peritoneum has a special power of resistance and repair after diffuse infection with septic organisms or tubercle bacilli, and in a minor degree, after diffuse invasion with cancer cells of ovarian origin
- 2 It is possible for nature unaided to cause the retrogression of peritoneal metastases and the gross limitation of a diffuse malignant condition into operable tumors
- 3 Radium, which is known to be the most efficacious in those new growths which are clinically most benign, may also aid the peritoneum in a battle which otherwise is only slightly in favor of the growth

Principles—I The most malignant characteristics of cancer are (a) Its insistence on growth (b) Its absorbable poison which produces cachexia (c) Its tendency to metastasize Beyond these three mysterious characteristics it has only mechanical terrors. Even these mechanical terrors would be controllable to a large extent by ordinary surgery, for we can do plastics on erosions, suture perforations and remove mass pressure

### E A CODMAN

- 2 Therefore, the treatment of cancer in general should aim at (a) providing a direction of least resistance for the growing cells, and at conducting the growth toward a point at which we can bring its enemy, radium, to meet it, (b) at maintaining the fluid lymph-flow from the rest of the body out through the malignant tissue, so that the cachetic poison will be released instead of being absorbed, (c) preventing metastasis by intelligent attention to the pressure exerted by growth in the deepest cells
- 3 Ovarian malignant disease lends itself peculiarly to this treatment because it is papillomatous in type, has a large fluid draft, and clinically is known to have a mild cachexia and a low metastasizing power, also normal ovarian tissue is known to be especially sensitive to radiant energy

I hope that when you next run across one of these hopeless cases, you will at least give these theories of treatment a trial Personally, I believe they form rational principles for the treatment of cancer in general

# TRANSACTIONS

OF THE

# PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, held April 4, 1918

The President, DR EDWARD MARTIN, in the Chair

TREATMENT OF GUNSHOT FRACTURES OF THE MANDIBLE

DR JOHN B ROBERTS read a paper with the above title, for which see page 245

Dr Hunter W Scarlett said that during two and a half years at the Ambulance in Paris, there were treated many gunshot fractuers of the jaw and face, and he was enabled to follow several of these cases. He then showed a series of pictures of two cases, in which there was extensive loss of bone and soft tissue and with no possibility of retaining bone fragments or of applying splints. In the first case, after thorough cleansing and removal of foreign material from the wound, the tissues were approximated as nearly as possible to the normal. When the scar tissue contracted to the utmost, and the time for operation arrived, they excised the scar, dissected back the flaps and approximated the soft tissues. After that the dental surgeon took charge of the patient. The benefit derived from the plates which he inserted was quite marked. In the beginning of the treatment of the case it was, of course, necessary to feed the patient by a tube through the nose. After the plate was made, the man was able to chew with a certain amount of comfort.

In the second case, in which the fracture was received just inside the angle of the jaw, reduction was made before the patient came to the hospital. The pictures show the great amount of mutilation of the soft tissues and the result obtained by simply excising the scar tissue, dissecting the flaps well back, and approximating the two edges

DR GEORGE P MULLER noted that in the gunshot injuries of the jaw encountered in the War, hemorrhage is an occasional complication, and contrary to experience in civil surgery comes from the distribution of the lingual artery in the majority of cases

DR PENN G SKILLERN, JR, with reference to the relation of silver wire to necrosis of the jaw, said he thought that silver wire should be discarded in favor of an animal suture, such as kangaroo tendon. Sutures of this type placed in the mandible are not as irritating as silver wire and yet possess sufficient tensile strength, particularly if the tendon knots are reinforced by catgut suture knots, since the kangaroo tendon knot is very liable to slip. Wai fractures of the mandible are accompanied by greater loss of substance than the fractures encountered in civil life, in fact, a gap

### PHILADELPHIA ACADEMY OF SURGERY

in the mandible results in a large proportion of the cases The majority of ununited gunshot fractures occur on the lateral aspect of the mandible and exhibit a gap rarely exceeding 3 cm in length. He did not think sufficient emphasis had been placed upon the value of bone grafting in mandible In his opinion a bonegraft forms the most satisfactory splint for fractures of the mandible with breach of continuity While most of these fractures are compound yet the bonegraft resists infection sufficiently long to justify its use, especially if inserted after the acute infection has been It encourages reproduction of bone on the part of its host and acts as a scaffolding The proper distance of the fragments from one another can be maintained with the "shoulder graft"—a bonegraft provided with a couple of shoulders, which abut against the ends of the fragments and maintain their proper relation to the gap. The ends of the graft are fitted into gutters developed in each fragment and retained by kangaroo tendon sutures passed through drill holes and around the graft bonegraft screws give better fixation and he uses them in preference to kangaroo tendon because they make the graft mchanically a part of the The autogenous bone screws are passed through the graft into the mandible, and if the infection is controlled, as is now rendered more quickly possible with chemicals like dichloramine-T, which can be used in the mouth when dissolved in the non-irritating chlorcosane, the mandible in favorable cases will proliferate bone across the gap, guided by the graft

Destruction of the chin can be remedied by cutting a U-shaped graft from the upper portion of the tibia, the apex of the U corresponding to the tibial tubercle, which by its smoothness and prominence forms an excellent chin. This graft is then transferred to the mandible and secured to the margins of the defect

Destruction of the central portion of the mandible also can be remedied by a U-shaped graft, made larger than that for the chin, according to the extent of the defect The graft ends are fastened on each side to the body ends

Destruction of the body and part of the ramus of one side can be remedied by cutting an L-shaped graft from that portion of the tibia which extends from the inner surface of the internal tuberosity of the tibia downward and forward to include part of the tibial crest by kangaroo tendon sutures placed through drill holes the crest portion of the graft is secured to the stump of the ramus, and the tuberosity end to the symphysis end of the sound side of the mandible Platt, Campion and Rodway (Lancet, March 30, 1918, 461) report nine cases of mandible injury in which tibial bonegrafts were implanted successfully Cole (loc cit, 459) describes a novel pedicled graft method in the treatment of ununited mandible fractures

As to the source of the graft, that taken from the antero-internal surface of the tibia high up seems to work better than a graft from any other bone some, however, use the rib near the angle for this purpose, others, the crest of the ilium

### GUNSHOT FRACTURES OF THE MANDIBLE

DR EDWARD MARTIN said that he had taken some pains to ask dental surgeons in what way the general surgeon should cooperate with them in preparing the field for the really skilful technician. They advise first to fix in a position of good occlusion, to preserve the space between the lips and cheek to prevent dribbling, to employ, if we have it, the moulded splint containing the dentist's moulding wax. They advise against wiring or, on the part of the unskilled, an attempt at plaster-of-Paris work.

In regard to the wiring of which so much has been said, he asked an expert man to wire for a demonstration for his class a broken jaw made by a rifle bullet. In reply to his inquiries he said it would take him about an hour to do the work, and an inexperienced man three hours, further, that the fixation when done would not last. In view of this he asked, is it any use to teach men who are not expert the art of wiring? Do the dentists do it?

DR GASKILL (replying to Doctor Martin) said that wiring the mandible for fixation is the simplest form of splint. It can be done in a short time, and if the wire is sufficiently strong the fixation may last almost indefinitely. It is quite a simple matter

### ACUTE PANCREATITIS

DR JOHN B DEAVER read a paper with the above title, for which see page 277

DR GEORGE P MULLER asked Doctor Deaver if he ever attempted to get rid of the necrotic mass at the head of the pancreas. It is hard to understand how an incision in that necrotic, hemorrhagic mass can afford drainage. Doctor Deaver also spoke of waiting until there was recovery from shock. He wondered if he would not rather put it that energetic measures should be speedily adopted against shock? The probabilities are that the patient will not recover from shock while he has the pathology. Doctor Deaver will remember that in 1904 they read a joint paper on acute pancreatitis. He did not believe that except for improvements in operative technic that knowledge of this disease has been much advanced since that time

DR DEAVER, in conclusion, said that in a small percentage of acute pancreatitis he has found that pain was referred to the left shoulder and back. He used gauze packing for stopping the bleeding and drainage, which he allowed to remain in place until it became loose. He also stated that in bleeding after incising the necrotic pancreas if the gauze packing did not suffice he was usually able to check the flow of blood by through and through catgut suture

### CORRESPONDENCE

### SKIN ASEPSIS IN SURGERY

To the Editor of the Annals of Surgery Sir

Doctor O'Conor, in a letter to you published in your issue of April, 1918, draws attention to a fact which should, I think, be more widely known than, judging by the practice of many surgeons, it appears to be I refer to the passage in his letter in which he says, "I feel convinced that disinfection of the skin of the abdomen by tincture of iodine is a most dangerous procedure, and I regret to have to state that, in some of my cases, it has proved itself to be a veritable death trap" It is more than six years ago that I drew attention to the risks run by the adoption of this method of sterilizing the skin of the abdomen prior to opening the peritoneal (See "Practice and Problem in Abdominal Surgery," p 67) In support of the opinion therein expressed, I cited some experiments on dogs by Propping (Zentralblatt fur Chirurgie, Nos 19 and 26) who showed how readily adhesions formed when iodine was applied to the surface of the peritoneum M H Walker and L M Ferguson (Annals of Surgery, February, 1916), experimenting on rabbits, also demonstrated the dangers dependent on the contact of the drug with serous surfaces, and expressed their opinions in these words "Iodine should be used in abdominal surgery with great care, or better not used at all, for a very little of it allowed to touch the bowel causes masses of adhesions" I sought again to draw attention to the subject by a short contribution to the British Medical Journal in 1916 (vol xi, p 75), feeling that it was of sufficient gravity to warrant a wider recognition than it yet seemed to have received The use of 10dine has become so general in application as a pre-operative means of sterilizing the skin that the danger of its use in certain individual cases is still overlooked, and with too little regard for the importance of the matter. many surgeons are so satisfied with present results that they lose sight of the possible ills which the future may reveal. It is with the hope of not only further ventilating the possible deleterious effects of this dangerous practice, but of drawing attention to actual facts recorded by Doctor O'Conor -so much more forcible and convincing than mere expressions of opinionthat I have ventured to address you on the subject. There are many other ways of efficiently sterilizing the skin without endangering the peritoneal surfaces, and I am old-fashioned enough still to cling to Listerian practices by using carbolic lotion in strengths of 1 in 40 and 1 in 20 former is applied as a wet compress for twelve to twenty-four hours before the operation (when time will allow) and the latter for an hour prior to making the incision In cases of urgency, the I in 20 strength is alone used.

A ERNEST MAYLARD

### CORRESPONDENCE

### SIMPLIFYING CEREBRAL LOCALIZATION

To the Editor of the Annals of Surgery

A number of methods for locating the fissures of Rolando (central) and Sylvius have been described in the text-books, the simplest being those of Kronlein and Kocher They are all more or less open to objection, being complicated, owing to the efforts of their originators to consider the cranium and its contents from a mathematical standpoint

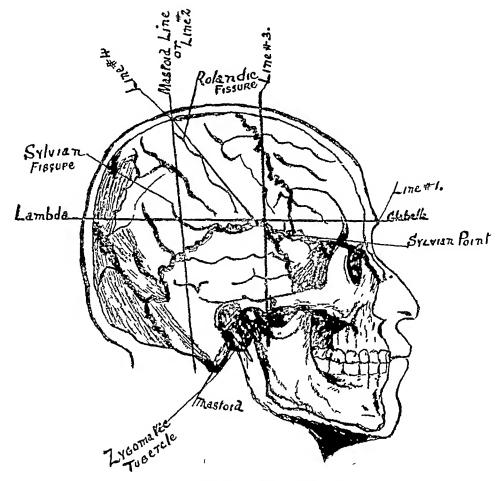


Fig I -Lines for cerebral localization

In text-book descriptions instructions are given to locate certain points by measuring fixed distances from other points and then run lines at fixed angles, or what is worse, one is instructed to use a certain number of degrees from the perpendicular which necessitates the use of some form of instrument. This is all very confusing and tends unnecessarily to complicate matters because all crania are not of the same size or outline, hence, it follows that no one mathematical formula would fit all cases even were it simple.

The following method has been found useful and is simple in that it requires no measurements or mathematical processes. It is based on bony landmarks of the skull which are easy of location and it will be found that most brains occupy the same relative positions to these landmarks

### CORRESPONDENCE

The osteoplastic flap being the method of choice in the great majority of brain operations insures that this method will be found sufficiently accurate. In any analysis it will be found to be much more accurate than any mathematical method.

The method requires four lines run from five landmarks First, a line from glabella to lambda Second, a line perpendicular from the posterior part of the mastoid to the sagittal suture. Third, a line perpendicular from the tubercle of the zygoma to the sagittal suture. Fourth, an oblique line connecting the junction of the zygoma-glabella-lambda lines with the junction of the mastoid-sagittal suture lines. This oblique line will practically cover the central or fissure of Rolando (see Fig. 1)

The Sylvian point may be located in two ways. First, it lies almost beneath (and for practical purposes may be considered to do so) the tip of the greater wing of the sphenoid at its junction with the frontal and parietal bones. Second, a line drawn perpendicularly upward from the middle of the zygoma until it meets the glabella-lambda line will cover it at the latter junction. If the glabella-lambda line is followed from this junction to its junction with the mastoid-sagittal suture line the fissure of Sylvius will be outlined with sufficient exactness for any surgical purpose.

In addition, the line from the tubercle of the zygoma to the sagittal suture almost covers the course of the anterior branch of the middle meningeal artery. The artery being slightly anterior below the glabella-lambda line and slightly posterior above, but in no part being more than a quarter of an inch distant.

There is a saying that "There is nothing new under the sun," and this method may not be, but I have been unable to find such a description in anything at my command. It is certainly much simpler than anything commonly described in the text-books

F W RINKENBERGER, M D, Seattle, Wash

July 2, 1918

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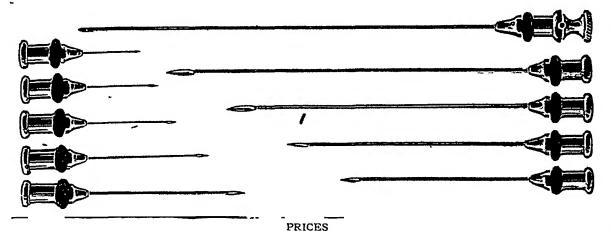
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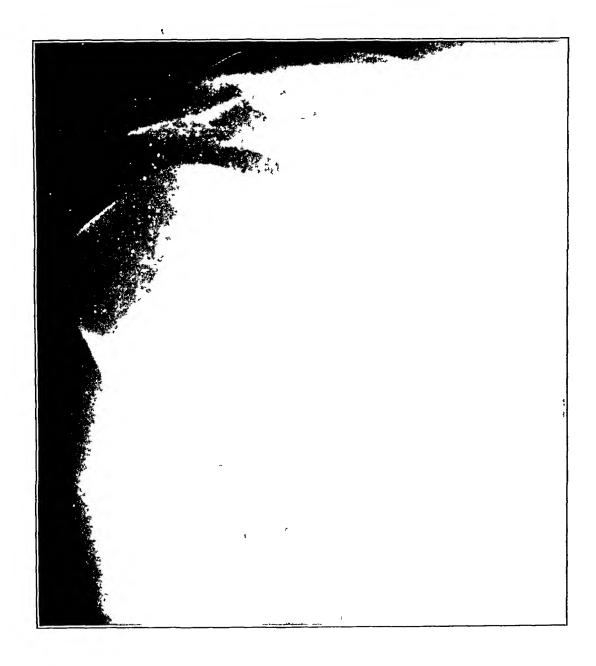
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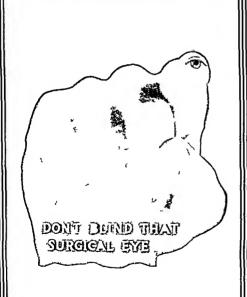
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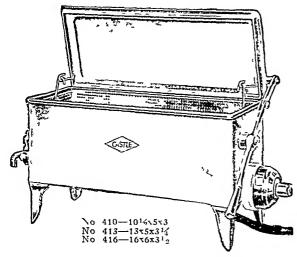
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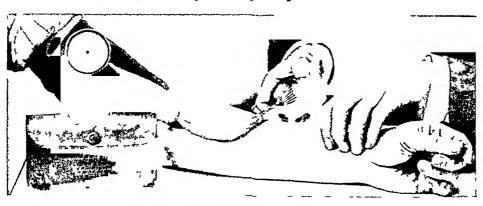
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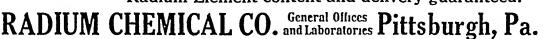


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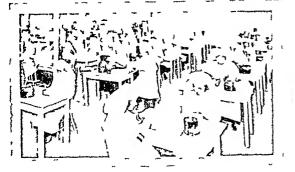
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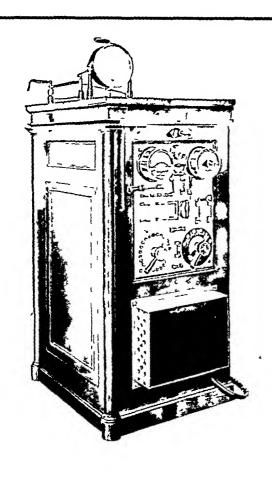
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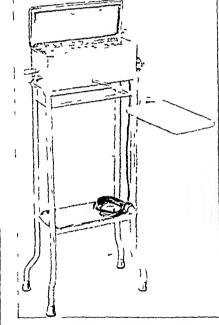
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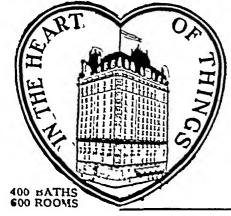
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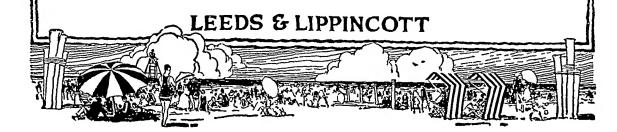
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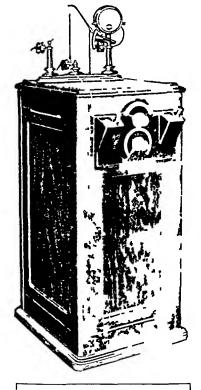
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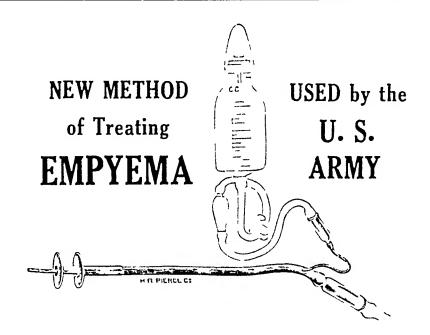
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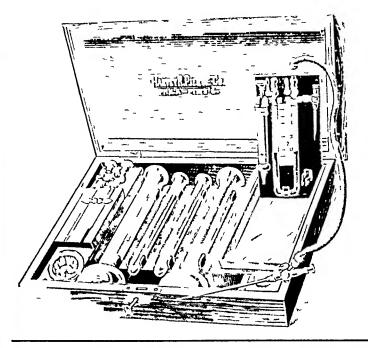
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## ANNALS of SURGERY

Vol LXVIII

OCTOBER, 1918

No 1

### THE TREATMENT OF TUMORS OF THE SUPERIOR MAXILLA BY HENRY H JANEWAY, M D.

OF NEW YORK

During the past three and a half years, fifty-five patients with tumors of the superior maxilla have been treated at the Memorial Hospital by radium, assisted when necessary by a conservative operation. These tumors have included eight benign tumors and forty-seven malignant growths, of which four were sarcomas and forty-three epitheliomas.

The anatomical classification of these tumors in one group belonging to the upper jaw is somewhat arbitrary, because the superior maxilla forms the walls of at least three well separated cavities, the antrum, the nose, and the mouth. The vast majority of the tumors originate from the mucosa lining the walls of these cavities, and the mucosa of each cavity presents somewhat different characters. Nevertheless, the new growths, originating in all three of these cavities, present similar clinical and therapeutic problems, and this fact justifies grouping them together.

Benign Tumors—Of the benign tumors the papillomas are the simplest There are two very definite varieties of papilloma. One is the simple circumscribed papilloma, showing little tendency to metaplasia and resembling in every way the similar and far more common warts of the skin

Only one patient, Hospital No 23827 of our series, possessed one of these growths. It grew from the mucosa, covering the inferior surface of the palatine process of the superior maxilla of a woman forty-nine years of age. The tumor had been growing, before she applied for treatment, for one and a half years. She received a single treatment of radium on February 8, 1917, 225 mc having been applied in three rubber-covered platinum tubes for two hours. A complete disappearance of the growth resulted.

These tumors are more frequent on the tongue and lip and, in these regions, after varying lengths of time, they may undergo malignant transformation, doubtless because on the tongue, but more especially on the lip, they are subject to frequent trauma

The other variety of papilloma is a much more important tumor. It forms, early in its growth, sessile and very superficial minute papillary projections, which spread superficially over large surfaces. At the starting place, these tumors are prone, after a longer or shorter time, to deeply infiltrate and become true epithelioma.

An example of such a tumor is A M, Hospital No 25090. The microscopical examination of the specimen removed from the surface of the

Š.

growth showed a papilloma, but the base at the center of the growth was infiltrating and possessed potentially all the life-destroying characters of true cancer. In another patient not included in this series a growth starting in the lower alveolus and involving, at the time he applied for treatment, the soft palate, cheek and lip, showed the same type of papilloma in the first specimen examined, but a deeper specimen obtained at a later date showed fully developed epidermoid carcinoma

Another patient, J K, Hospital No 25190, who had, at the time he came for treatment, fully developed epidermoid cancer of the whole of both superior alveolar processes and the intervening palatine processes of the superior maxilla, developed his cancer from an invasive growth of one of these papillary superficial growths starting seven years before

These papillary growths are easily cured by surface applications of radium. We have obtained a good result in practically all of them, and such a result is nothing short of curing cancer.

The case of myxoma occurred in a young girl, eighteen years of age It was first noticed seven months before she applied for treatment. The first symptom was a swelling of the face below the eye and to the side of the nose. The growth showed itself very susceptible to radium and was cured, but unfortunately the treatment was unnecessarily severe and caused some facial deformity.

Closely allied to the myxomas are the fibrosarcomas We have met with two of these growths In both patients the tumors started to grow in the nose and subsequently invaded the antrum While both patients showed a susceptibility to radium, the treatment was not successful, due chiefly to the late stage and very large size of the growths at the time the treatment In these late growths, completely blocking the air passages was applied and producing distention of the nasal and antral cavities, it is wiser to relieve the patient in part by a preliminary operation, which serves also another purpose of rendering the pedicle of the growth more accessible to the subsequent application of radium By so doing, the dangers of infection and post-treatment swelling, which in one of these advanced cases actually led to suffocation, will be greatly diminished. At the present time we are treating a third case of fibroma or fibrosarcoma of the nasal cavity of smaller size It does not originate from the mucous membrane covering the superior maxilla, but more posteriorly from that over the adjacent portion of the palate bone

This growth was recurrent after operation, and it has been treated by embedding within it unfiltered glass emanation tubes. The improvement to date has been satisfactory

The osteomas of the antrum form an interesting group of tumors Two patients have come under our care

While radium cannot reduce these growths in size because of the fact that the dense bone of which these growths are formed does not become absorbed, it is of material service in stopping further growth

Our first patient was a boy, twelve years old The tumor was first noticed several months before he applied for treatment, and, according to the family's statements, had been gradually becoming larger Our treatment consisted in chiselling away the bulk of the tumor through an opening made within the mouth in the anterior wall of the antrum This operation consisted practically of carving out a new antrum from the solid bone which completely filled the former antral cavity and had become consolidated with its walls

After the operation 50 mc of radium emanation filtered through 05 mm silver were placed in the cavity for six hours. Following this treatment, administered 'October 20, 1915, there has been some continuous diminution in the slight residual prominence of the left cheek and certainly no continued growth of the bony tumor. The result, therefore, to date is most satisfactory from both a cosmetic and a functional standpoint

The second patient, Hospital No 25108, was a woman, 62 years old, who had first noticed a swelling of the face one and a half years ago. The usual operation of removal of the floor of the antrum, done in the radium department of this hospital, for exposure of the antral cavity, was performed, and a large part of the tumor removed. The remainder of the tumor was treated with radium. Complete healing soon followed, and the patient has been free from any further increase in size of the growth since the treatment, and, also, from any inconvenience in the normal function of the mouth

Of two patients with giant-cell sarcoma, the one received a single treatment with, in so far as could be ascertained, complete retrogres-This patient died later of some unknown cause woman fifty-eight years of age, whose attention was first attracted to her disease one year before applying for treatment by the appearance of a nodule in the neighborhood of the left lateral incisor tooth At the time of treatment a sinus had been created by an operation and the sinus was continuous with tumor tissue inside the antrum The second patient, Hospital No 25324, is a young girl, sixteen years She first noticed symptoms four months before admission These symptoms were a diffuse swelling of the right side of the roof of the mouth and a little later epiphora and nasal obstruction The swelling in the mouth was incised at another hospital under the impression that it was inflammatory. At the time of admission the right side of the face was much swollen The palatine and alveolar processes of the superior maxilla were depressed, and a mass of new growth obstructing the nose could be seen through The patient is still under observation at the the anterior nares hospital

The single patient with chondroma of the superior maxilla, Hospital No 25395, possessed a previous history of his lesion of ten years' duration. The tumor began to grow in the left antrum. It recurred after operation in both superior maxillæ, completely blocking both sides of the nose. In structure the growth showed large spindle cells so that the tumor is more strictly a chondrosarcoma, but clinically

it is quite benign in its course. The patient received treatment from unfiltered glass emanation tubes embedded in the substance of the tumor. Little retrogression up to the present time has taken place, the patient having only received treatment on April 24, 1918.

The single case of melanosarcoma of the superior maxilla was unaffected by radium therapy. The history of this patient, Hospital No 23921, is one of considerable interest, as these tumors are rare in this location. The growth developed in a man, fifty-two years of age, in the left superior alveolar process in 1911. It gradually increased in size, and was operated on in March, 1912. In December, 1915, local recurrence was noticed, and enlargement of the cervical lymph nodes. These were removed in December, 1916. Following this operation and the treatment by radium soon afterwards, the patient's general health and strength rapidly deteriorated.

The microscopical sections of the tissue, taken from within the mouth, show a moderately cellular tumor involving the epithelial layers of the alveolus and underlying tissues. It is composed of long spindle cells, closely packed together and lying in a dense intercellular substance. The epithelial layer is invaded in numerous places by the tumor cells. Heavily pigmented cells are present below and within the epithelial layer, and in foci throughout the tumor, and especially in large spindle and polyhedral cells about the edges of the tumor cell groups

Malignant Epithelial Tumors of the Upper Jaw —Of all the tumors of the upper jaw, carcinoma attracts the most attention, first, because of its by no means infrequent occurrence, and, second, because of the serious nature of the course which it runs

In our series, it occurred no less than forty-three times among fifty-five patients with tumors of the upper jaw. The following shows the relative frequency of the various tumors of our series. Carcinoma, 43, sarcoma, 3, melanosarcoma, 1, papilloma, 2, osteoma, 2, chondroma, 1, fibroma, 2, myxoma, 1

Carcinoma of the superior maxilla is, therefore, by far the most frequent tumor of the superior maxilla, all other tumors being relatively so infrequent that they may be considered rare

Between the years 1915 and 1917, inclusive, 1892 patients with malignant tumors were admitted to the Memorial Hospital, 48, or a percentage of 253, of these were cancers of the superior maxilla

During the same period, 786 patients were treated in the radium department, and of these 40 were malignant new growths of the superior maxilla, a percentage of 5 08

Of the 786 patients admitted to the radium service, 353 patients had cancer of the mucous membrane of lip, interior of the mouth, pharynx, larynx, and esophagus, of which the 40 malignant tumors of the superior maxilla form 11 33 per cent

Of the 1892 patients admitted to the hospital during the three years,

1915 to 1917, 285 patients had sarcoma Deducting these, there were 1607 patients with malignant epithelial tumors Of this number,

38, or 2 35 per cent, were cancers of superior maxilla, 53, or 3 29 per cent, were cancers of the lip, 115, or 7 16 per cent, were cancers of the tongue

Cancer of the superior maxilla is, therefore, almost three-fourths as frequent as cancer of the lip, and one-third as frequent as cancer of the tongue

The site of origin of cancers of the upper jaw bears a direct relation to the prognosis. They may be divided into antral, nasal, and oral. It is not always possible, at the time the patient comes for treatment, to distinguish between the tumors which are primary in the antrum and those primary in the nasal cavity. For this reason, a more practical classification might be the antro-nasal tumors, and the oral tumors

In twenty-one of our patients the tumors began to grow in the mouth upon the superior alveolus

In eighteen patients the growth was judged to have originated within the antrum, but of this number the antral origin of six was somewhat doubtful

In the case of four patients, the disease originated either within or in close relation to the nasal cavity

The following table gives the distribution of these growths according to sex and side of the body affected

	No	Male	Female	Right	Left	Both
Oral cases	21	17		10	5	2
Antral cases	18	11	4	<b>2</b> 6	2 5	
Nasal cases	4	3	7	5 3 1	2	
	43	31	12	27	14	2

The table shows that a majority of the lesions occurred in the male sex, and on the right side of the head. The explanation of the greater frequency in the male sex and of the greater frequency of involvement of the right side in both sexes is a matter of speculation.

The mucous membranes of the male sex are subjected to more chronic irritation. Men smoke more than women, they are engaged in occupations subjecting them to the inhalation of dust and inflammatory conditions depending upon outdoor occupations more than women. One very probable factor, accounting for the greater frequency of the oral cases among men, is the greater neglect of the teeth by men and the irritating effects of chewing tobacco. In the majority of the oral cases of this series the teeth

were decayed or covered with deposits, and surrounded by pyorrheal pockets. There are, however, no facts which support the view, that habit subjects the right side of the mouth to such irritation more than the left side.

In only seven of the patients was there a history of heavy smoking, and in two others, a history of chewing tobacco. In seven of the patients the beginning of the disease was associated with loosening of the teeth, or decayed teeth, but there is no definite evidence to show whether this condition of the teeth was a result or a cause of the disease. In one of the antral cases there had been a prolonged history, extending over years, of nasal polypi before the onset of the trouble. In another patient trauma from a broken piece of enamelware directly preceded the development of the growth

Age—Sixty-nine per cent of the cases occurred between the ages from forty-five to seventy, and 28 5 per cent between fifty and sixty years of age

The following table shows the number of cases occurring in the different five-year periods from fifteen years of age to seventy

	15-19	20-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70
	Male Female	Male Female	Male Female	Male Female	Male Fem1le	Male Female	Male Female	Male	Male Female	Male Female	Male
Oral cases Antral cases Nasal cases	I	1	I 2 I	I I 2	I	2 I I 2 I	I 4 2	5	III	4 I 2	2
	I	2	3 I	2 2	1	4 3	5 2	5	2 I	6 I	2

### SYMPTOMS OF ONSET AND DURATION OF THE DISEASE BEFORE APPLICATION FOR TREATMENT

The symptoms of onset are of much importance, as so much can be accomplished with these cases when treated early

The oral cases are the easiest to diagnose in the early stage, and in the majority of these the first symptom is ulceration. A few complained of loosening of the teeth in the superior alveolus. The subsequent symptoms are increase in size of the ulcer, swelling of the superior alveolus and later of the face. An intelligent patient will usually seek medical advice when the lesion is small.

In the antral cases the first symptom may be any one of the following named in order of their frequency

Irritation of the eye, due probably to obstruction of the lachrymal duct, swelling of the face or alveolus, nasal obstruction, or pain or loosening of the upper teeth

Among the nasal cases, nasal obstruction and discharge and irritation of the conjunctiva were the initial symptoms. Any recurrent or persistent conjunctival irritation, not affecting the whole conjunctiva uniformly but more intensely the conjunctiva in the neighborhood of the lachrymal duct,

particularly if coupled with some nasal obstituction, coming on without the ordinary symptoms of a cold in the head, should excite the suspicion of being caused by a tumor within the antrum Transillumination and a radiograph then become valuable diagnostic aids

Sooner or later, there is marked swelling of the face and alveolus with evident distention of the antrum, more complete nasal obstruction, or if the oibit becomes invaded, which it frequently does in the nasal cases, exophthalmos develops. Pain now becomes added to the other symptoms, nutrition becomes interfered with, and the patients progressively lose in weight and strength, until death occurs. Figures I and 2 illustrate well the swelling of the face

The regional lymphatics become involved rather late in the course of the disease. The following table gives the average duration of the disease from the time when symptoms were first noticed until (in the first column) the patients applied for treatment and (in the second column) until they were referred to us. In the third column is the average total duration of the disease in the case of those patients who died, and in the fourth column the percentage of patients who developed enlarged regional lymphatics, at least as long as they were followed by us, which represents the whole of the disease in many and most of it in others

		of t	he disea	se before	of the	e disoas	e before	
Oral cases Antral cases Nasal cases			7 I months 4 months 5 75 months		13 7 months 14 3 months 5 75 months			
Average length of the					age of cases developing d cervical lymphatics			
13 8 months	Average of 4 cases only, the others still			Lymp	ymphatic involvement			
12 4 months 5 months	living	of 5	cases		cases	with 7 6	without 14 12	
	13 8 months	who have died  13 8 months Average of only, the living Average of	Average length of the disease in those provided  13 8 months   Average of 4 only, the other living   Average of 5	Average length of the disease in those patients who have died  13 8 months  Average of 4 cases only, the others still living 12 4 months  Average of 5 cases	Average length of the disease in those patients who have died    Average length of the disease in those patients who have died   Percenta enlarged	Average length of the disease in those patients who have died  Average of 4 cases only, the others still living  Average of 5 cases  Oral cases	Average length of the disease in those patients who have died  Average of 4 cases only, the others still living Average of 5 cases  Of the disease before applying for treatment of the disease being reference being reference being reference being reference applying for treatment of the disease being reference being reference capplying for treatment of the disease being reference being reference being reference capplying for treatment of the disease being reference being reference capplying for treatment of the disease capplying for the dise	

Among the oral cases the shortest duration before applying for treatment was one month, the same case having been referred to us five months from the initial symptom, and the longest duration before treatment twenty-four months, among the antral cases, the shortest duration of the disease before the application, for treatment was one month, the same case being referred to us three months from the appearance of the first symptoms. The longest duration of the antral cases before treatment was 156 months, the next longest 24 months, and the next 12 months. Among the nasal cases the shortest duration of the disease before applying for treatment was one month, the same case being referred to us two months from the onset

The longest total duration was eleven months Malignant new growths of the superior maxillary bone untreated run their whole course most frequently well inside of one year, few lasting as long as two years, and whenever the total duration of the disease is over one year, it is due to the fact that histology represents a specially benign type of growth, or the administration of a more or less successful treatment

#### THE PATHOLOGY OF CARCINOMA OF THE SUPERIOR MAXILLA

Aside from the adamantinomas, of which we have no examples in our series though the tumor occurs in the superior maxilla, we have met with four types of epidermoid cancer of the superior maxilla which present both different clinical features and different pathological pictures

The simplest form of cancer of the superior maxilla possesses a papillary structure (Fig 3) Its epithelial cells form solid intertwining columns with no invasion of the intervening connective tissue. The cells and their arrangement are atypical, and their growth is unrestrained. We have met with two examples of this growth, F. H., Hospital No. 24423, and H. W., Hospital No. 25176. Both growths occurred in comparatively young individuals. F. H. was a woman of forty years, and H. W. a man of thirty-eight. Both had a previous long history, one thirteen years, and the other eighteen years, the growth showing no tendency to metastasize, simply progressively increasing in size until interrupted by a more or less successful operation. When these patients applied to us for treatment, their tumors distended the antrum, and filled the nasal cavity of one side, and death seemed, and probably was, near

In the case of F H, a single application of radium, embedded as emanation in unfiltered glass tubes in the center of the growth, caused a complete retrogression with no return to date, an interval now of one year H W is still under treatment. At some time in their course these tumors take on a rapid growth and quickly terminate life

Possessing from the beginning true invasive characters are two varieties of carcinoma of the superior maxilla Both are typical epidermoid cancer

One of these is the ordinary squamous cell cancer, containing pearls, and composed of large atypical pavement cells of the spinous type or type of the more superficial layer of cells of squamous epithelium (Fig 4)

These tumors belong, so far as we could ascertain, entirely to the oral group of cancers of the superior maxilla

They are very malignant, though following the rule of most of the malignant growths of the superior maxilla, they involve the regional lymphatics late, causing death usually by a rapid local growth.

The other type of invasive epidermoid cancer has been found chiefly

The other type of invasive epidermoid cancer has been found chiefly among those tumors originating within the antrum. The sections all show basilar cell features. The epithelial elements show groups or strands of cells lined peripherally by a layer of atypical cuboidal or columnar cells (Figs 5 and 6).

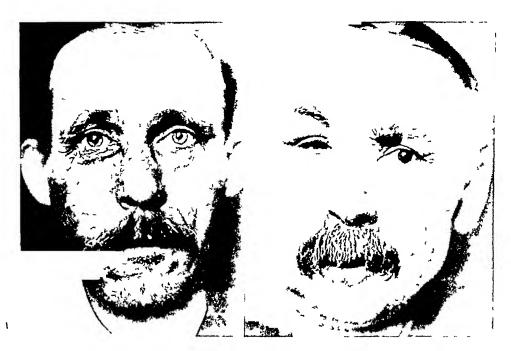


Fig r —Illustrating distention of the face by epithelioma of the antrum This patient is now apparently cured

FIG 2 —Illustrating swelling of the face caused by epithelioma primary in the superior alveolus



Γις 3 —Papillary carcinoma of the superior maxilla

FIG 4—Epithelioma of the squamous cell type epithelioma spinoccllulare of the superior maxilla

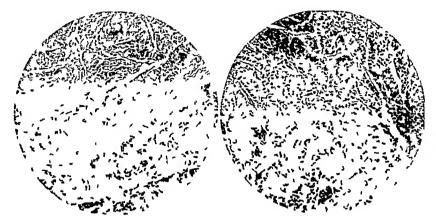


Fig 5 —Epithelioma of the cylindrical cell type epithelioma basocellulare of the superior maxi'la

Fig 6—Epithelioma of the cylindrical type epithelioma basocellulare of the superior maxilla



F G 7 — Schneiderian epith lioma primary growth (a very cellular growth) often classified a. a sarcoma

Fig 8 — schneiderian epithelioma liver metastasis



Fig 9—Epithelioma of the superior maxilla showing features of growths originating in the Schneiderian mucosa In this tumor cylindrical cell features are apparent

Γις 10—Adamantina of the superior maxilla

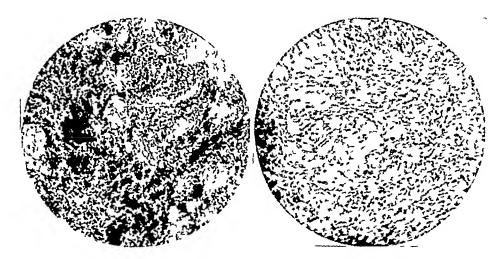


Fig 11 —Embryonal epithelioma of the superior maxilla

Fig 12 —Embryonal epithelioma of the superior maxilla (from a metastasis)

The epithelial cells in both these varieties of epidermoid cancer are invasive

The columnar cell type is as malignant as the squamous cell type and in no way resembles in its clinical course the basilar cell epitheliomas of the skin. In several of our cases the regional lymphatics were involved and the course of the disease was just as rapid as in the tumors atypically reproducing the more superficial cells of squamous epithelium.

The fourth form of epithelial cancer of the superior maxilla represents an atypical proliferation of cells characteristic of the Schneiderian mucosa All those tumors classified as the nasal group have shown these characters

They are all very cellular tumors with little tendency for the cells to be arranged in groups or columns, separated by connective tissue, the connective tissue elements being very scanty. The cells are polymorphous, preserving little of the form typical of any of the cells of the normal mucous membrane.

These tumors are by far the most malignant of all the tumors of the superior maxilla. Three of the four occurred in relatively young people, one in a young girl of seventeen, another in a man of twenty-eight, a third in a man of forty-eight, and the fourth in a man of sixty-two. The total course in the man of twenty-eight was only four months, and in the man of sixty-two, Hospital No 24837, was five and a half months. This patient died in the hospital and a post-mortem was performed. His radium treatment had successfully eliminated the local disease, and though there were no involved regional lymphatics, the liver was studded with metastases, and the thoracic and abdominal lymph nodes invaded as low as the portal vein

The cranium was not opened, but from the symptoms immediately preceding death, cerebral metastases were suspected Figs 7 and 8 show the structure of his tumor

Figure 9 shows the structure of the tumor of the young girl of seventeen It possesses a more organized morphology in which the cylindrical cells more characteristic of antral tumors are apparent. All four of these tumors not only filled the antrum and invaded the nasal cavity at the time they were referred to us for treatment, but in each case the orbit had also been invaded.

In at least three, the largest amount of the tumor was in the antrum,  $\iota$  e, this cavity seemed to be most extensively involved

Adamantinomas, of which none of the superior maxilla have been treated during the past three years at the Memorial Hospital, form a special and fifth group of epitheliomas of the superior maxilla. Doctor L'Eperance has described eight of these growths, of which at least two were of the superior maxilla. They present a characteristic histology, and show no disposition to form metastasis, but a strong tendency like the basilar cell carcinomas of the skin to recur locally. Fig. 10 illustrates the structure typical of these growths

Some of the growths of the superior maxilla show marked embryonal

features We have met with a good example of one of these in a patient treated at the Memorial Hospital, but not in the radium department. The histology is so perfect that the accompanying reproduction (Fig. II) has been added

One patient of our series, Case No 1, Hospital No 21606, belongs most probably to this embryonal group We are unable to reproduce a section of the primary tumor, but Fig 12 shows the structure of one of the metastases Her course is remarkable from both a pathological and clinical standpoint. Her clinical history is given with the other case-reports under the discussion of treatment.

Treatment—In the treatment of carcinoma of the antrum, as is the case with the surgical treatment of cancer, our results bear a direct relation to the stage of the disease in which the patients come to us

Those patients, who were treated in an early stage, while the disease was still small and localized to its primary seat, have given to date excellent results with radium alone. In those patients in whom the disease was still further advanced but yet well circumscribed, good results have been obtained by the use of radium, combined with a conservative operation which rendered the whole region involved more accessible to the radium. In the more advanced cases the same plan has given good temporary results, but none of these patients has been cured

In an early growth still well circumscribed upon the alveolar border, even if it involves the adjacent portion of the cheek, a radium applicator can be made of dental modelling compound, which may be filled with filtered emanation tubes. We sink the tubes whenever possible to a depth of five mm, and distribute them as uniformly over the surface as possible, generally using enough tubes to make one tube for every I sq cm, or I¼ sq cm

Such an applicator may be held in the mouth of the patient for any reasonable length of time, one to four hours if necessary, and will cover the lesion accurately. For superficial lesions we use one-half mm of silver as a filter. In deeper cases we use one mm of platinum

Whenever there is the slightest suspicion that the growth may have penetrated into the antrum—and it must not be forgotten that it often begins in the follicles of teeth which open into the antrum—or when we are dealing with a growth which is primary within the antrum, some operation must be performed which thoroughly exposes this cavity. I do not believe that anything is gained in those tumors primary in the antrum, or in the more advanced alveolar cases, which have invaded the antrum secondarily, by the disfiguring operation of resection of the whole of the superior maxilla through the usual incision of the Ferguson-Webber operation below the eye and along the side of the nose and through the lip, or by making a direct opening through the anterior wall of the antrum from the surface of the face. These operations seldom succeed in removing all the disease, so that, if an ultimate cure is to be expected, some other agent, as radium, must be depended upon. An operation which provides

good drainage to the antrum and enables the operator to expose the whole of the disease intimately to the radium is alone necessary of the superior alveolar process and sufficient of the adjacent portion of the hard palate, as may be necessary in case the nasal cavity has been invaded, accomplishes this purpose. This procedure can easily be accomplished, together with a preliminary ligation of both external carotids, under local anæsthesia. The neck work is done under infiltration anæsthesia and mouth work by induction anæsthesia, the emerging branches of second and third divisions of the fifth cranial nerve being easily reached by a long needle appropriately introduced below the malar bone This operation gives excellent diamage and perfect exposure and, whenever it is unnecessary to invade the nose, very little inconvenience to the patient afterwards, as the opening fills in and contracts down in a most satisfactory manner When it is necessary to remove enough of the haid palate to open the nasal cavity, a plate may be worn later

The nasal cases must be managed differently In all four patients of this series, the cavity of the orbit had been invaded. In order to obtain proper access in these cases, it is necessary to remove the eye, the orbital plate of the ethmoid and the floor of the orbit. This procedure gives complete exposure to the antrum, the orbital cavity and the nasal cavity

Any temporary opening of these cavities by an incision beginning above the eye and along the side of the nose will surely be followed by disappointing results. Case I, K, Hospital No 24837, was the only one of the nasal cases treated in this manner. This patient had a very malignant tumor and died afterwards of internal metastasis, but the local treatment was successful in causing a complete retrogression of the disease at its primary site.

Of the forty-three patients with carcinoma of the superior maxilla a complete retrogression to date has been obtained in eight. Only one of these eight patients has been traced to date. When last seen he was free from disease. On the other hand, there promises yet to be a favorable result in two other patients still under treatment.

The seven patients with complete retrogression traced to date form 162 per cent of all the cases treated, many of which were advanced and wholly inoperable

The time limit is, of course, an important factor. Only two of these patients are within a few months of the three-year period. The other five have passed a little over one year since their treatemnt was administered. Nevertheless, the presentation of this report at the present time, even though it must be considered a preliminary one, is justified for the following reasons. The majority of recurrences of cancer of the upper jaw take place within less than a year's time. A percentage of clinical cures to date of 162 per cent in a series containing many advanced and inoperable cases promises a more favorable result by the method used than can be obtained by operation alone.

Scudder in his book on tumors of the jaws has collected the more important series of carcinomata of the upper jaw treated by operation alone up to 1912, and Tschistjokoff, in 1914, has published an additional statistical report of twenty-five cases. These series may be tabulated as follows.

Author	Source	No of cases	Operative mortality	Cures
Martens	Ohlemann Kuster Bırnbaum Braun Winiwarter Batzaroff	49		2 (4 per cent)
von Stein Fuchs Martens Martens Scudder Tschistjokoff*	von Petzold Berlin Clinic Breslau Clinic Konig's Clinic at Göttingen Gussenbauer Clinic Massachusetts General Hospital	13 23 48 32 12 25	19 0 7	0 0 8(16 6 per cent) 2 (6 2 per cent) 2 (16 per cent) None reported

<sup>\* (</sup>From Chirurgia, 1914, xxxv, 187 Reviewed in Surgery, Gyn and Obstet, 1914, xix, 590

A comparison with these operative results supports the belief that the use of radium materially increases the therapeutic possibilities of cancer of the upper jaw and with far less risk

In the article by Martens, Deutsche Zeitsch für Chir, 1896-97, xliv, 483, the mortality of 124 cases operated on by Burns, Heyfelder, Ried, V Langenbeck, Dumreicher, Esmarch, Beck, Bryk, Wilms, Simon, Billroth, Merkel, and Konig was 44, or 35 5 per cent

In the most favorable cases the use of radium alone may produce a cure, it did so to date in two of our seven cases. In the more advanced cases it may cure when its use is combined with a less extensive and less disfiguring operation It accomplished this result to date in three of our seven cases and in two others it produced a cure in growths recurrent after operation in other hospitals There has been no immediate mortality among our cases and there should be no unfavorable results in the wise use of radium Aside from overdosage in the primary treatment, which it is, of course, most important to avoid in all radium therapy, the next most important consideration is the avoidance of undue persistence in the treatment of those cases which have shown only a limited improvement after the first Many of these limited improvements mean much to the patient and it is, therefore, most tempting to continue their treatment, but nothing is of greater importance for the future comfort of those patients who cannot become cured than to recognize when all that is wise has been accomplished for them

The following are the clinical records of the cases which have undergone a complete retrogression to date

Case I —D MacN, female, age thirty-four years, married, two children, Hospital No 21606 Condition on admission, November 13, 1914 A small, flattened, rather soft, discoid-shaped prominence is present in the scar upon the right cheek, passing beneath the eye and down along the side of the nose This scar is the usual one left after resection of the superior maxilla

History—In October, 1912, a tumor grew from the anterior wall of the antrum, producing a swelling on the cheek. An attempt was made to remove this by a local resection. It recurred, and in April, 1913, the attempt was repeated by resecting the anterior wall of the antrum. Later the lymphatic glands of the neck became enlarged, and in July, 1913, and again in September, 1913, all discoverable glands were excised. The above-described recurrence in the scar of the face was first noticed two weeks ago.

Pathological Examination—Epidermoid carcinoma

Treatment—November 13, 1914, 25 mc applied for fifteen hours in one plaque of rubber-covered lead 1 mm thick. Following this treatment there was a rapid disappearance of the lesion

February 13, 1917, no evidence of disease was present

August, 1917, the patient was again admitted to the hospital with a large discoid swelling of the scalp over the left parietal bone. The tumor was very firm and hard, immovable, and measured 3 cm by 6 cm, and elevated  $2\frac{1}{2}$  cm. Another similar tumor was present on the ulnar surface of the right forearm

Treatment—August 2, 1917, 391 mc applied for twelve hours to the lower portion of the tumor on the scalp in 17 silver tubes ½ mm thick inclosed in 1 mm lead and distributed over an area of 35 sq cm at a distance of 4 cm

August 3, 1917, 552 mc applied for 14½ hours to the upper part of the tumor in the parietal region in 12 lead containers 2 mm thick at a distance of 2 cm

August 4, 1917, 456 mc applied for 18 hours in 12 lead containers 2 mm thick over the tumor of the forearm at a distance of 6 cm

August 5, same treatment continued

Ten hundred and two mc applied over forearm for 10 hours in 12 lead containers 2 mm thick at a distance of 6 cm

All tumors disappeared after these treatments, and on March 1, 1918, there was no evidence of disease

Case II—M C, male, age sixty-five years, Hospital No 22203 Condition on admission, July 1, 1915 An ulcerated mass of neoplastic tissue, presenting an irregular worm-eaten surface, involves the remnants of the external wall of the antrum, the inferior and internal walls of which have been previously resected. The growth involves the entire thickness of the tissues of the cheek, producing externally an ulcerated mass, one inch in diameter, and raised one-quarter of an inch

History—The growth was first noticed three and a half years before admission as a small ulcer upon the left upper alveolar process. Two years ago an attempt was made to completely remove it by a resection

of the alveolar process He first noticed a recurrence two months ago, when there was fresh ulceration both inside the mouth and on the outside surface of the cheek

Treatment—July 6, 1915—One hundred mc applied inside the mouth for 12 hours in one rubber-covered tube of ½ mm silver, and 75 mc, in one plaque of rubber-covered silver 1 mm thick, applied over the ulcer on the cheek surface for 12 hours

September 1, 1915, 100 mc applied in one tube of rubber-covered silver 0.6 mm thick, inside the mouth for 8 hours

November 10, 1915, a progressive retrogression has taken place and, at present, no sign of his disease remains. It has been impossible to trace the patient since this time

Case III—T T, male, aged twenty-nine years, single, Hospital No 22731 Condition on admission, August 11, 1915 An ulcerated nodular mass, 2 cm in length, and 1 cm in width, is growing from the anterior portion of the upper wall of the right antrum. The remaining walls of the antrum have been removed by operation about the middle of April, 1916

Diagnosis - Epidermoid carcinoma

History—In March, 1915, a swelling appeared external to the first molar tooth on the superior right alveolar process. This increased in size, and the superior maxilla was resected in April. The recurrence was noticed soon afterwards.

Treatment — August 11, 1915, 100 mc applied for 8 hours in one rubber-covered tube of 06 mm silver

September 1, 1915, marked retrogression

September 25, 1915, 200 mc applied in one rubber-covered plaque of 1 mm silver for 6 hours

November 16, 1915, a new ulcerated tumor has developed upon the internal surface of the inferior turbinate

November 17, 1915, 75 mc applied in three rubber-covered tubes to the new ulcer for 5 hours

No recurrence has developed since this time

Case IV —M S, male, age forty-seven years Hospital No 23773 Condition on admission, September 24, 1916 Projection from superior right buccogingival groove is an egg-shaped mass, 3 by 2½ cm in diameter. It is relatively soft and bleeds easily when traumatized. It produces a discoid prominence of the cheek over the antero-external wall of the antrum.

Diagnosis - Epidermoid carcinoma

History—He first noticed the disease six weeks ago, and consulted a dentist, who pulled a tooth adjacent to the tumor. The three remaining teeth in the upper jaw are mere stumps. For years he has neglected his teeth, but they have never pained him. He is a heavy smoker (ten cigars a day). He denies syphilis. His general health has always been good.

Treatment—September 24, 1916, 225 mc applied for 6 hours upon the tumor in nine rubber-covered 1 mm platinum tubes

November 9, 1916, there is a complete disappearance of the ulcera-

tion and tumor mass inside the mouth. The swelling upon the face has been transferred into a flattened fluctuating prominence

November 13, 1916, 540 mc applied for 12 hours over the swelling on the cheek at a distance of 2 cm in twelve lead tubes, 3 mm thick

November 27, 1916 Fearing invasion of the antrum, the superior alveolar process or floor of the antrum was removed. The cavity was found filled with tumor tissue.

December 19, 1916, 228 mc applied for 2 hours within the antral cavity in six rubber-covered 1 mm platinum tubes

Following this treatment, there has been no return of the disease to date

CASE V—F H, female, age forty years, married, seven children Hospital No 24423 Condition on admission, May 21, 1917 A scar left after a previous attempt to resect the superior maxilla is present beneath the right eye and along the side of the nose Filling the angle between the eye and nose is a discoid prominence, 4 cm in diameter. It is formed by the protrusion forward of the skin of the face by a tumor mass, which fills the remnants of the antral cavity and the right nasal cavity.

Enlarged lymph nodes are palpable on both sides of the neck

History—Thirteen years ago a swelling developed in the region of the right upper alveolar process. Two months later, the superior maxilla was resected. She remained well for ten years. Three years ago a recurrence developed. This was again removed by operation and she remained well until five months ago, when a recurrence again developed and progressively grew to the present size. Otherwise her previous health has been good.

Pathological Report —Solid masses of epidermoid carcinoma, probably of dental origin, infiltrating edematous connective tissue

Radium Treatment —Seventy-five mc in five unfiltered emanation tubes inserted into the substance of the tumor for fifty hours. At the end of this time, the tumor tissue was curetted out after ligating the left external carotid, the right external carotid was found to have been previously ligated. Following the operation, the patient ran a temperature for a couple of weeks

Extensive sloughing followed the application, but this ceased and on November 9, 1917, no evidence of tumor tissue could be discovered

CASE VI—H K, male, age sixty-six years, married Condition when treated, May 9, 1917 In the roof of the mouth, between the middle line and the left superior alveolar piocess, the patient being edentulous, is a slightly elevated, hard ulcer with a nodular surface, and elevated hard, somewhat irregular edges It measured 234 cm by 214 cm in diameter

History—The patient first noticed the present lesion six weeks ago At that time, it was half the present size. A decayed tooth had been present for some time contiguous to the ulcer. These were extracted at this time.

Pathological Report — Epidermoid carcinoma

Radium Treatment—One hundred ninety-two mc applied for 3½ hours in eight 1 mm rubber-covered platinum tubes

June 20, 1917, retrogression almost complete

August 17, 1917, retrogression complete

March 8, 1918, no evidence of disease

Case VII—C B, female, age thirty-seven years, single, Hospital No 24516 Condition on admission, June 19, 1917 Small fistulous opening leads into left antrum through the canine fossa within the mouth Around the mouth of this opening, upon the alveolar process, is an ulcer, the surface of which is covered with neoplastic nodules

History—In August, 1916, the patient had the left upper wisdom tooth extracted because of attacks of rheumatism. Six months ago (January, 1917) she developed pain in the left side of the face. At times this pain was referred to the upper jaw, and at other times to the lower jaw. A radiograph was taken, which disclosed an opacity in the left antrum. Eight weeks ago the pain became more severe, and two weeks ago the antrum was opened, and examination of the curettings showed carcinoma.

June 25, 1917, under general anæsthesia, the superior left alveolar process was removed, thoroughly exposing the antral cavity

Radium Treatment — July 6, 1917, 198 mc applied for 2 hours in eleven ½ mm silver tubes, embedded in a mold of dental compound

Healing progressed satisfactorily and all local disease retrogressed, with no return to date

Case VIII—W S, male, age fifty-seven years, married Hospital No 24738 Condition when admitted, September 1, 1917 On the left side of the roof of the mouth and alveolar process, and involving to a small extent the adjacent portion of the cheek, is a slightly raised growth, 2 cm square Its surface is irregular, nodular, and hard, but shows little ulceration

History—The present lesion was first noticed one year ago. It caused the patient no inconvenience until six months ago. He then consulted a dentist, who applied silver nitrate, and later a physician, who curetted the lesion. Following this treatment, it recurred and grew more rapidly. The patient has always smoked heavily, but attributes his disease to the irritation caused by poorly fitting artificial teeth. He denies venereal disease. His father died of cancer of the stomach.

Pathological Report — Epidermoid carcinoma No metastasis found in the lymph nodes subsequently resected

Treatment—September 1, 172 mc in eight ½ mm silver tubes, applied 1 mm deep over an area of 12 sq cm in a mold of dental compound, 2 hours

October 6, under local anæsthesia, the floor of the antrum was removed after ligating both external carotids Considerable tumor tissue had invaded the cavity of the antrum, 415 mc applied 1½ hours in nine ½ mm silver tubes distributed over 15 sq cm of a mold of dental compound at a depth of 1 mm

Following this treatment the lesion rapidly retrogressed, and at present there is no evidence of a recurrence

Twenty patients were improved, but the improvement in the majority of them was only of short duration, although in many of them no evidence of disease could be found for a time. When recurrence develops in cancer of the antrum or nasal cavity, it progresses rapidly and only under exceptional circumstances is it wise to continue treatment. Six of these improved cases belonged to the alveolar or oral group, twelve to the antral group, and two to the nasal group.

The two following case-reports illustrate the character of improvement obtained in some of these cases The first case belongs to the antral group, and the second to the nasal group

CASE IX—L B, male, age forty-nine years, married, three children Hospital No 24388 Condition on admission, May 8, 1917 The left side of the face below the eye and zygoma as far down as the mouth is swollen to a height of 2½ cm above the normal level of the cheek. The skin over the swelling is tense and somewhat reddened Inside the mouth, in the left buccogingival fold, is a scar in the center of which is the opening of a sinus from which blood mixed with puspozes.

History —In the middle of February, 1917, he noticed some deterioration of his general health. In the middle of March he began to feel pain in his face. An attempt was made to relieve this by the extraction of a tooth. Soon after this the face became swollen and the pain became more severe. Toward the end of March a growth was noticed in the left nasal cavity. His previous health has been good with the exception of frequent attacks of biliousness. He denies venereal infection

Pathological Examination —A compact, very cellular, epidermoid carcinoma

May 9, 1917, under local anæsthesia, both carotids were ligated, and the floor and lateral walls of the antrum removed

May 14, 1917, radium treatment

Three hundred four mc in sixteen 1 mm platinum tubes applied within the antral cavity, 2 hours

June 8, no evidence of disease could be discovered

November 14, a recurrence discovered

November 24, radium treatment

One hundred two mc in  $\frac{1}{2}$  mm silver upon the surface of a dental mold of an area 4.5 sq cm applied to the interior of the antrum 3 hours

December 28, only a slight improvement in the cavity of the antrum, and recurrence of tumor in the tissues of the cheek

January 3, 1918, two bare emanation tubes of 74 mc each inserted into the recurrence in the cheek

March 15, he reports that the tumefaction in the cheek has disappeared, but that his eye is beginning to protrude. Further treatment deemed inadvisable

CASE X — J K, male, age sixty-two years Hospital No 24837

Condition on admission, October 10, 1917 The right eye protrudes forward in exophthalmos (11 mm) There is considerable chemosis of the conjunctiva Through the anterior naris a mass can be seen which is apparently invading the right nasal cavity from its external wall No enlarged glands are palpable in the neck

History—Seven to eight weeks ago the right eye began to "water" He attributed the trouble to an inflammation of the eye, and it was severe enough for him to consult a physician. No evidence of the presence of a new growth was discovered. Five weeks ago he first noticed the development of exophthalmos. Four weeks ago he went to Bellevue Hospital, and a week later the eye became blind. The sight of the left eye is unimpaired. He smokes only moderately. States that he had gonorrhæa and a chancre forty years ago. For the syphilis he received treatment for only a short period.

Pathological Report —One fragment removed from the nose Inflamed cellular carcinoma arising, probably, from transitional epithelium Later another report from tissue removed at operation

Solid cellular highly anaplastic carcinoma, containing a few small pearls

October 20, 1917, operation under local anæsthesia, later supplemented by ether The external carotid was ligated, and the eye enucleated, and all the new growth within it removed. This involved the removal of the floor of the orbit and the lateral wall of the nose, as the new growths had invaded the antrum and nasal cavity.

Radium Treatment —Two hundred and sixty-five mc applied to the interior cavity left by the operation in five 1 mm rubber-covered platinum tubes for 8 hours Following this treatment, the cavity healed smoothly, and at no time afterwards was there any evidence of new growth remaining within it

On December 28, 1917, the patient became very restless, and later irrational, and finally passed into coma He died January 1, 1918

Autopsy (January I, 1918) —Heart Size, chambers, muscles normal, all valves slightly thickened and soft Atheroma in the aorta extensive Lungs Congested Beginning consolidation in the right lower lobe. There are numerous miliary and larger opaque tumors in the parenchyma of both lungs. Intense bronchitis Spleen Large, soft, and congested Liver Very much enlarged, uniformly studded with tumor nodules miliary to the size of a marble. Portal nodes much enlarged with tumor tissue. Other abdominal organs normal. Thoracic and abdominal lymph nodes involved as low as, but not beneath, the portal vein. The lymph nodes of the neck are free from carcinoma.

Of the remaining patients, ten were unimproved, and four are still under treatment

Five of the unimproved patients belong to the alveolar group, and three to the antral group, and two to the nasal group

#### THE OPERATIVE TREATMENT OF TRIFACIAL NEURALGIA

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THERE is no pain quite so severe, agonizing and at the same time comparatively so intangible as that of neuralgia of the trifacial or trigeminal nerve, the so-called "tic douloureux" In the milder cases, however, the pain may be so intermittent that a number of days or even weeks and months may elapse without there being even a sensitive twinge, and then again, in the more severe cases, the pain may be practically continuous, always associated with spasmodic facial contractions, these latter cases are usually the end-results of the former milder ones, upon whom every known medical treatment has been used, and only too frequently with little or no success

True trifacial neuralgia rarely occurs in people under forty years of age, in fact, those cases developing under fifty years of age should be most carefully examined, especially regarding the incidence and character of the attacks and whether associated with facial spasm, a mistaken diagnosis can be very easily made—hysteregenetic pain possibly being the most frequently confused, while neuritis of the systemic type or due to a local irritation, such as dental lesion and a latent sinusitis, particularly of the homolateral antrum, should be most carefully excluded before the final diagnosis of trifacial neuralgia is confirmed

The pathology of trifacial neuralgia is still obscured, in the majority of the patients, no lesion of the trifacial nerve or of its Gasserian ganglion (vide Fig I) can be ascertained, in some of the specimens there were indeed neuritic changes, particularly an increase of the connective tissue with an abundant vascularity, but I feel that these changes in many of the severe cases requiring finally the ganglion operation are more the result of the former treatment, especially the injection of alcohol into the peripheral branches with a resulting ascending neuritis even into the Gasserian ganglion itself, rather than being primarily due to the condition itself. No doubt carious teeth with root abscesses and sinus infections may originally be factors in predisposing to trifacial neuralgia, but in my series of patients, it seems that these dental and sinus lesions were but incidental and not in any way etiological factors. In almost all of my patients upon whom the major operation of evulsion of the posterior sensory root or a removal of the Gasserian ganglion had to be performed, the history of the former treatment in addition to the routine medical measures was practically the same, that is, if the pain began in either the upper jaw supplied by the second peripheral branch of the trifacial nerve or in the lower jaw supplied by the third peripheral branch, then in each patient the adjacent teeth were extracted, and if the pain did not subside, then a peripheral nerve resection,

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alcoholic injection, and, finally, in a small number of patients, even an attempt to inject alcohol into the Gasserian ganglion—a medieval method similar to the former blind aspiration of the gall-bladder and distinctly more dangerous, the alcoholic injection of the Gasserian ganglion cannot be too strongly condemned, as it is, in my opinion, of greater danger to the life of the patient and the probability of serious complications so much graver than the major operation itself, to insert a needle blindly (as the measurement and angle of each cranium widely vary) through the foramen ovale into only the Gasserian ganglion and then to force alcohol into the ganglion and nowhere else—such as the adjacent subdural spaces, cavernous sinus, carotid artery, et catera (and those complications have been reported), is distinctly a much greater risk than the major operation itself

In the diagnosis and treatment of patients having true trifacial neuralgia, the greatest care must be used and all the modern methods utilized, first, in order to ascertain the true condition, and, second, if the condition is undoubtedly trifacial neuralgia, then the application of the palliative expectant treatment in its various forms in the hope that the condition can be improved, if not permanently relieved, this happy result can be obtained in a small percentage of patients having true trifacial neuralgia. Naturally, the major operation should not in any case be advised until it is proved beyond a doubt that the milder methods of treatment are of no real benefit to the patient—becoming more and more physically and nervously exhausted. Morphia, in any of its various forms, should not be administered to these patients, it frequently happens that the combat against the morphia habit must be started immediately after the major operation, and sometimes without lasting success. Most important diagnostic aids in excluding the common local causes

Most important diagnostic aids in excluding the common local causes of a peripheral facial neuritis are rontgenograms of the teeth and the osseous dental canals, of the sinuses, particularly the ipsolateral antrum and frontal sinus (to be further confirmed by transillumination), and then, affected much more infrequently, of the contiguous facial bones and even of the bones adjacent to the foramina at the base of the skull, especially the greater wings of the sphenoid and also the petrous portion of the temporal bone, in this latter connection I shall discuss more in detail, at the end of this paper, the probability of an exostosis pressing upon the Gasserian ganglion as a possible etiological factor in some patients. I have yet to see a patient having a true bilateral trifacial neuralgia, I feel that if a patient complains of pain in both sides of the face then the patient is not suffering from true trifacial neuralgia—the cause of the neuritis being rather a general systemic one, or a bilateral local lesion of the teeth or of the sinuses, visual impairments may also be a factor in those bilateral pains, the associated gastric disturbances usually indicate a migrainous condition

A source of local irritation and infection is undoubtedly present in a large number of so-called cases of trifacial neuralgia—in reality, however, a condition of neuritis, the teeth are most frequently involved and then possibly the sinuses, syphilis must always be excluded, also malignant

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growths at the base of the skull adjacent to the foramina of the peripheral trifacial branches. Naturally, the appropriate treatment is advisable according to the local lesion found, but, as frequently happens in the true cases of trifacial neuralgia, no local or general cause for the pain can be ascertained, and it is in these latter patients that it is absurd to extract normal teeth, and to perform the various sinus operations in the belief and the hope that the pain will then subside, naturally, if there is a definite dental or sinus lesion, then that condition should be removed, but to perform dental and sinus operations when no lesion can be demonstrated and only in the hope that "good may come from them" is not creditable either to modern surgery or to the specialist himself

In the typical cases of time trifacial neuralgia, there can be ascertained no local source for the irritation of the peripheral nerve branches. All of these patients, however, should be given a course of systemic treatment, diet and appropriate medicine, in the hope that the pain may possibly be lessened, the local applications of heat, cold, salves, electricity, diathermia and whatever means may be considered of possible benefit. They usually fail, but still I feel that they should be given a thorough trial if successful, excellent, and if they fail then no real harm has been done except of continuous and prolonged pain upon the general condition of the patient. This treatment, however, should not be continued longer than from three to six months, and if no definite relief has been obtained within that period of time, then, if only the area of the face supplied by one trifacial nerve branch is involved, the question of injecting alcohol into the peripheral branch, or even its peripheral evulsion and possible removal, may be considered

It should be remembered in this connection that many patients having true trifacial neuralgia suffer very intermittently in the beginning of the condition and this initial mild stage may continue for two or more years. For this reason, some local remedies have been undeservedly eulogized merely because the pain happened to cease within a few days or even weeks during their application. I have yet to see, however, a true case of severe trifacial neuralgia of its three branches amenable for any length of time to any kind of treatment other than the successful alcoholic injection of the individual branches, their resection or evulsion and the major operation itself upon the Gasserian ganglion. The methods of alcoholic injections (vide Fig. 2) and of resections of the peripheral branches are naturally of only temporary benefit—the pain usually returning within one year. The longest period of relief obtained by either of these procedures in any of my patients was nine months, whereas the major operation upon the Gasserian ganglion results in the permanent relief from all pain in the area supplied by the affected trifacial nerve

If all three branches of the trifacial nerve are involved, then it is of little benefit to attempt to remove the pain by the injection of alcohol into the individual branches. Not only does it require frequent injections, but the pain in such patients is rarely relieved—one branch or the other being

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continuously affected, besides, it seems that the frequent use of alcohol causes in some patients an ascending neuritis to occur so that apparently the Gasserian ganglion itself may be thus involved. Naturally, when this does occur, and it may even result from injecting alcohol in one branch only, then severe pain appears in all of the branches and no relief can be obtained by any of the peripheral procedures since the nerve irritation in or about the ganglion is central to the peripheral injection of alcohol, nerve resections, and nerve evulsions, the major operation upon the ganglion is now the last hope of relief. I still use alcohol for peripheral injection in all patients having only one branch affected, preferably the second or third branches, but if both these two nerves are continuously affected and of great severity, then I do not hesitate to advise the major operation as a sure means of immediate relief and an operative procedure to which all of these patients must eventually come—but only too frequently in a greatly exhausted condition entailing much needless suffering due to the unwise delay

The resection of a peripheral branch, and, better still, its evulsion at the distal foramen of exit, can be advocated in selected cases after the failure of alcoholic injections to influence the pain when one branch is affected, and even when two branches are involved, but to advise these peripheral operations when all three branches are causing severe pain or after the positive injection of alcohol in the nerve itself has definitely proved that the nerve irritation is central to the peripheral branch external to the foraminain these latter cases it is distinctly foolhardy to expect nerve resections or even evulsions to cause a cessation of the pain, in these patients, nothing but the ganglion operation will suffice If, however, a peripheral resection is considered advisable or, better still, an evulsion of as large a portion of the branch as can be wound about dissecting forceps (usually one to two inches), then by no means should the incision be made on the outside of the face but rather inside of the mouth with retraction of the cheek muscles for both the second and third branches, and only at the supra-orbital notch need a small external slit in the skin be made to permit an evulsion of the first branch, novocaine usually suffices The surgical mutilation by external operations upon the faces of these unfortunates is notorious and can no longer be defended

The majority of patients having the condition of true trifacial neuralgia have, as a rule, passed through these various stages of treatments so that I have been spared the unsatisfactory use of them. I must also state in this connection that hysterical facial pain has frequently been mistaken for trifacial neuralgia and naturally the peripheral alcoholic injections and nerve resections have been of no benefit to the patients, and it does seem that dental and sinus lesions may be the forerunners of certain cases of true trifacial neuralgia—at least the reports from the dental and sinus operations would indicate a pathological process of varying degrees in many of the patients

We now come to that large class of patients having finally, at least, the condition of true trifacial neuralgia—whatever the antecedent history—

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and all medical treatment and peripheral nerve operations have failed. What now is the best means of assuring relief to the patient? There remains no doubt regarding the advisability for these patients of the operation upon the Gasserian ganglion—and better still, the evulsion of the ganglion's posterior sensory root from its origin in the pons, with the ganglion exposed, this can be very easily performed by means of a small blunt hook about the sensory root just posterior to the ganglion and a gentle traction made outward so that the torn end of the root can be pulled forward and exposed over the ganglion. In this manner the motor branch is usually spared and the former difficulty of extripating and removing the ganglion itself is thus avoided, this operation of evulsion of the sensory root is the operation of choice and by it a permanent relief of pain can be assured to the patient

A number of operative routes have been devised to approach the ganglion itself. The former osteoplastic flap operation of Hartley-Krause is now no longer used, by it not only was a large bone flap turned down with a consequent large amount of blood lost, but by its being higher on the side of the skull it was necessary to retract the brain upward strongly in order to obtain a good exposure of the ganglion and thus the danger of cerebral complications was to be feared

The operation as devised by Cushing is in many respects undoubtedly the best operative method in that it approaches the ganglion through a small bony opening at the side of the base of the skull—the lower angle of the bony opening being made on a level with the ganglion itself, in this manner, the retraction upward of the overlying dura and adjacent brain is the minimum necessary to obtain an excellent exposure of the ganglion and its sensory root, the loss of blood is comparatively slight and the operative difficulties, if encountered, can be readily dealt with through this opening, in fact, in this operation the larger the opening the greater danger of operative complications. Following the method of Cushing, the anæsthetic is administered and the operation is performed with the patient in the usually horizontal position—the head slightly elevated, but the patient not in a sitting or reclining position, this latter posture is undoubtedly an excellent one for an operator accustomed to it and it is claimed that the hæmostasis is more easily obtained

The best operative exposure is obtained through a small curved incision of about 5 cm in length extending from a point at the upper border of the zygomatic process and about 2 cm anterior to the external auditory meatus (vide Fig 3), the incision curves upward and forward until it approaches within 2 cm of the external orbital rim and no farther for fear of injuring the frontal branch of the facial nerve with a resulting paralysis of one-half of the frontalis muscle—a very noticeable deformity. This incision extends through the skin and subcutaneous tissues down to the temporal fascia, small curved hæmostats are applied to the subcutaneous fascia and, as the same method of manual pressure-traction is used as in the operation of subtemporal decompression, the loss of blood is so minimized that it is practically nil

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A curved incision is now made, parallel with the skin incision, through the temporal fascia and its underlying temporal muscle down to the bone, and two small curved retractors quickly inserted both to control the loss of blood and to enlarge the exposure (vide Fig 4), the zygomatic process is not resected and it is not necessary to remove it in order to obtain a better exposure unless the skull and face of the patient are unusually broad I have been obliged to resect the zygoma in only one patient

To open the skull, and then to enlarge the bony opening, the same technic is used as in the operation of subtemporal decompression 1 (vide Fig 5), that is, the Doyen perforator and burr are used to penetrate the thin portion of the exposed bone down to the dura and then this small bony opening is enlarged by rongeurs, and especially downward to the base of the skull as far as possible, to a size slightly larger than a one-half dollar piece—usually about 3 cm in diameter. With efficient retraction this bony opening permits an excellent exposure of the Gasserian ganglion and any possible operative complications can be properly controlled through it, not only is any operative deformity thus avoided (the non-removal of the zygomatic process being a most important factor in this regard), but a careful hæmostasis is much more easily obtained and thus the necessity of a second-stage operation is rarely obligatory

A special dural spatula-retractor of the width of 15 cm is now inserted downward and forward between the bone and the dura (vide Fig 6) Care must be taken not to tear the middle meningeal artery in its dural, course and thus avoid the complication of troublesome hemorrhage, the dura should be gently separated from the bone and what little oozing of blood occurring can be well controlled by small cotton pledgets wet in warm normal saline solution The operator must not be in a hurry and impatient if slight delays occur—otherwise the danger of complications is much greater I know of no operation that requires more patience and is such an excellent test of the operator's self-control, as well as the assistants' and nuises', than this ganglion operation, everything must "go smoothly," and if it should not, then it is necessary for the entire team to make it possible, the patient alone suffers when the operative technic is not most efficient firm retraction is essential, the almost continuous use of small cotton pledgets (the size of a ten-cent piece) is necessary to keep the ganglion field as dry as possible so that the second and third branches can be clearly seen and thus make possible a perfect orientation

For fear of complications it is always wise to expose the second branch as it enters the foramen rotundum, then by moving the retractor slightly backward, the third branch can be seen rising from the foramen ovale just anterior to the foramen spinosum through which the middle meningeal artery passes to attach itself to the dura. Where the second and third branches converge within the outer layer of the dura, there we know hes the Gasserian ganglion

<sup>&</sup>lt;sup>1</sup> American Journal of the Medical Sciences, April, 1915, No 4, vol cxlix, p 563

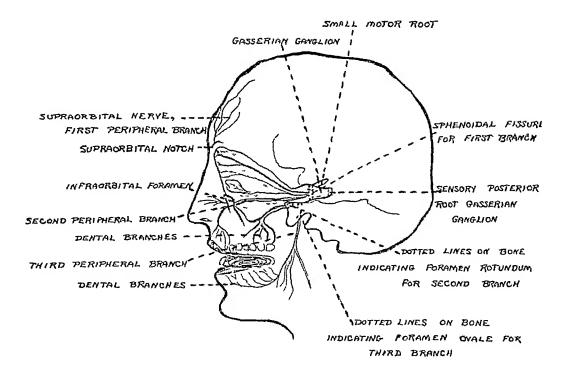


Fig. r —Sagittal section of Gasserian ganglion showing its peripheral branches their foramina of exit and their distribution

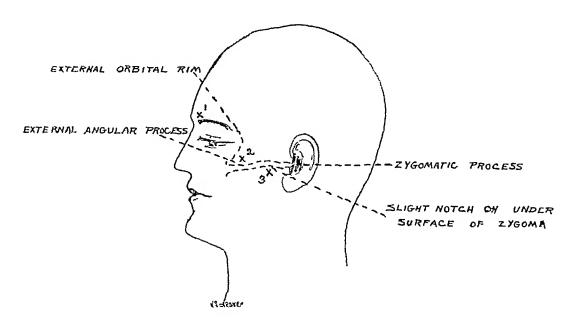


FIG 2—Points of election for alcoholic injections of the trifacial nerve—1 point for injecting the first branch in the supra orbital notch—2 point just above zygoma and posterior to the external process for injecting the second branch—needle to be inclined forward and downward—3 point just below inferior notch of zygoma for injecting third branch—needle to be inclined backward and upward

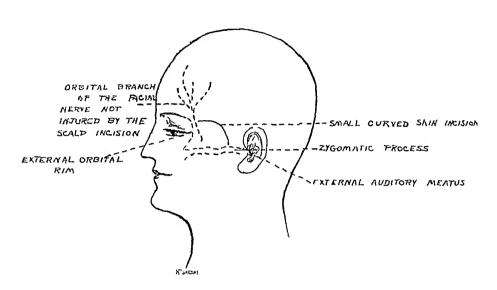


Fig. 3—Small curved scalp inci ion from upper border of zigomatic process and about one inch anterior to the external auditory meatus upward and forward to within three quarters inch of the external orbital margin—thus sparing the orbital branch of the facial nerve

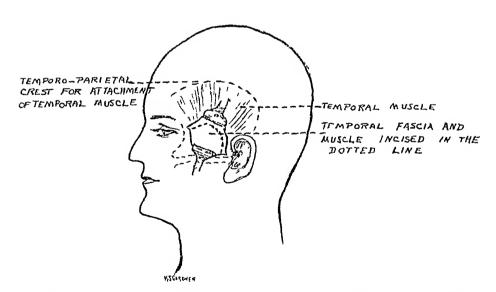
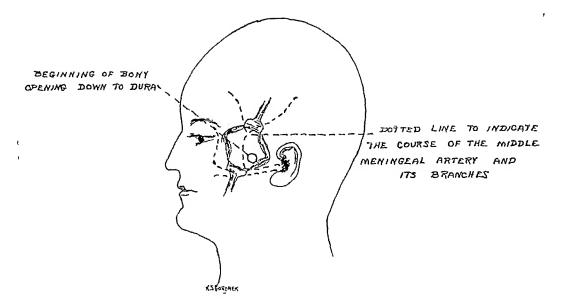


Fig. 4 —Showing the scalp retracted and the dotted curved incision through the temporal fuscia and muscle Relation of incision to the temporal muscle is indicated diagrammatically



 $F_{1G}$  5—Showing scalp temporal fascia and muscle retracted with pin-point opening of the bone down to the dura made by the Doyen perforator and burr, bony opening enlarged by rongeurs, dura is never opened

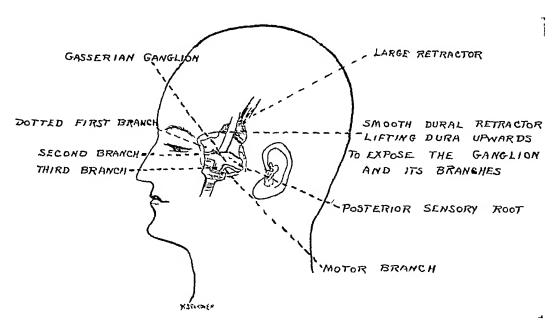


FIG 6—Schematic view—only the outer layer of dura over ganglion incised and retricted upward exposing the Gasserian ganglion its three peripheral branches the posterior sensory root and the motor branch. Small curved blunted hook used to evulse the posterior sensory root from its origin in the pons

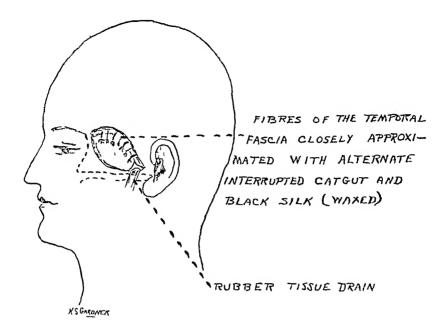


Fig 7 —Closure of operative incision a rubber tissue drain inserted at lower angle down to site of ganglion at base temporal muscle approximated closely by interrupted catgut sutures then temporal fascia sutured as above

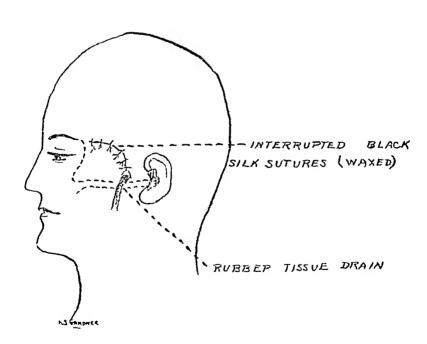


Fig. 8 —Scalp closure with fine black interrupted silk sutures (waved) Rubber tissue drain to remain in silu for twelve hours



Fig. 9—Gauze roller bandage applied and held firmly by adhesive strips. The homolateral eye not covered but the surrounding external angular process is carefully sealed by the bandage

### TRIFACIAL NEURALGIA

As the outer layer of the dura must now be incised just over and slightly posterior to the ganglion, it is frequently advisable to apply a silver clip to the middle meningeal artery just above the foramen spinosum so that there will be no danger of an annoying hemorrhage if the vessel should be torn. As a rule, however, I attempt the ganglion operation without this precaution, and then if arterial bleeding should occur, the vessel itself can be ligated after a delay of several minutes, the pressure of small cotton pladgets usually suffices. pledgets usually suffices

Upon incising the outer layer of the dura overlying the ganglion, the pointed nose of the retractor is slipped into the dural pocket of the ganglion so that an excellent exposure of the ganglion and the posterior root is obtained Troublesome venous oozing may delay a good exposure of the posterior root, but if patience and the continuous use of small cotton pledgets are persevered in, then these difficulties are usually overcome. When the posterior root can be seen accurately, then a small blunt hook can be safely passed about it posterior to the ganglion, and with gentle traction the root itself can be evulsed from its origin in the pons so that the torn end is seen pulled forward over the ganglion. It is usually possible to spare the motor branch—but not always. If after repeated efforts a good view cannot be obtained of the posterior sensory root as it enters the posterior portion of the ganglion on account of dural adhesions or troublesome oozing of blood, it is then advisable to remove the ganglion itself rather than to attempt to evulse the sensory root blindly and possibly not succeed. In all cases of doubtful evulsion of the sensory root, the ganglion should always be removed in order to be absolutely sure of its destruction. The overlying outer layer of the dura can be widely opened so that the entire ganglion is exposed lying in its dural bed, and after it has been freed of its adhesions by means of a small blunt dural separator, the ganglion itself can be pulled forward, frequently the posterior sensory root is evulsed by this procedure, but if there is any doubt of it at all, then the ganglion can be severed from its peripheral branches and removed in one piece or in fragments. The pozing of blood is always much greater in this method than if the posterior oozing of blood is always much greater in this method than if the posterior sensory root can be evulsed. Cotton pledgets wet in warm saline solution soon control the bleeding so that the closure can be made within a few minutes after the extirpation of the ganglion. After a rubber tissue drain is inserted to the bed of the ganglion (to be removed at the end of the operation), the dural retractor is withdrawn so that the dura now rises operation), the dural retractor is withdrawn so that the dura now rises to its normal position and thus compresses any small dural vessels that may have been torn. There being little or no bleeding, the fibres of the temporal muscle are sutured with interrupted catgut and then the overlying temporal fascia with alternate interrupted catgut and fine black silk sutures (waxed) (vide Fig 7), a firm closure is thus obtained. Interrupted catgut sutures are used for the subcutaneous tissue (vide Fig 8), while interrupted fine black silk sutures may be used for the skin (vide Fig 9). The drain of rubber tissue is now removed, unless there is some oozing of

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blood, if so, then the drain is allowed to remain until the first dressing, which is the following day, the second dressing occurs on the sixth day post-operative and all sutures are then removed, the patient is allowed to sit up and is usually discharged about the tenth or twelfth day

No protection of glass or gauze dressing is placed over the ipsolateral eye to prevent serious corneal complications in the belief that these measures merely tend to increase the danger of such irritations to an insensitive cornea, the patient is institucted before the operation about the danger of rubbing the eye, during the recovery from the anæsthesia the patient is carefully watched so that the eye itself is not touched, and then when the patient regains complete consciousness the eye is not treated at all—not even washed out with boracic acid solutions. In several of my earlier patients small corneal ulcerations appeared, due, as I now believe, to using protective coverings for the eye instead of letting the eye entirely alone—not touching or rubbing it either by hand or by a so-called protection. The instruction of the patient is possibly the most effective method of avoiding such complications.

In three patients upon whom I attempted the ganglion operation, I encountered such operative difficulties, particularly a general oozing of blood so continuously obscuring the ganglion, that I was obliged to finish the operation at a later date. These cases are rare and usually occur in patients having had a large number of alcoholic injections, which apparently increase very much both the vascularity and the adhesions about the ganglion

In two patients, malignant disease at the base about the foramina of exit of the second and third branches made the ganglion operation impossible, so that the second and third branches alone were severed. This intracranial sectioning of the peripheral branches of the trifacial nerve is naturally only a temporary palliative measure, with few exceptions it should never be performed, and it is by no means the operation upon the Gasserian ganglion, it seems that some operators believe this is the major operation itself and merely perform upon patients this temporary procedure, naturally, the pain returns within a year as a rule

It may be a coincidence, but my last three patients have each had a definite bony protuberance arising from the upper portion of the anterior surface of the petrous bone and extending apparently into the outer edge of the Gasserian ganglion, so that in order to approach the ganglion it was necessary to use a small chisel to remove the bony obstruction, at its inner side lay the ganglion. This bony process or possibly exostosis has been observed in several other patients and it may possibly be a factor in producing the condition of trifacial neuralgia which is always unilateral, the irritation of the ganglion by its direct or indirect pressure may be a primary cause of the conditions, it is significant in these last three patients, the pain originally began not in one branch but in two or three branches. This condition of a possible exostosis as a primary cause of some cases of trifacial neuralgia should, I feel, be considered

## A NOTE ON THE SURGICAL TREATMENT OF CERTAIN DISEASES BY SPLENECTOMY

By JAMES SHERREN, FRCS (ENG)

OF LONDON

SURGEON TO THE LONDON HOSPITAL

In a recent number 1 of the Annals of Surgery a paper by Balfour appeared recording a case of splenectomy for repeated gastro-intestinal hemorrhages. Shortly after reading it I received information of the sudden death of one of my patients from profuse hæmatemesis thirteen months after splenectomy had been undertaken for this reason. In view of this I thought it would be of interest to publish the case in full with notes of others in which hemorrhage has been a prominent factor.

I have carried out 14 splenectomies for disease, with one death—a boy of fourteen on whom it was performed for advanced cirrhosis of the liver. He had been ill five months with ascites and cedema of legs. At the request of the physician under whose care he came I decided to operate. There was marked cedema of legs and scrotum and fluid in the right pleural cavity. Wassermann examination negative. The operation presented no difficulties and the spleen, which weighed 17 ounces, was not adherent. He died forty-eight hours later.

The remaining cases were distributed as follows Splenic anæmia and Banti's disease, 9, Gaucher's splenomegaly, 1, hydatid cyst of spleen, 1, splenomegalic jaundice, 2

In three of the first group gastro-intestinal hemorrhage caused the patient to seek medical advice, two had been under treatment previously, diagnosed gastric ulcer

The first was a male of twenty-seven whom I operated upon on February 27, 1914 Until June, 1911, he was, so far as he was aware, well, except for occasional epileptic fits He then had a profuse attack of melæna A year later he had a further severe attack followed by several slighter ones A month before I saw him the diagnosis of Banti's disease was made by his medical adviser, Dr Cuthbeit Ede, by whom he was sent to Dr Robert Hutchison and to Sir William Osler The following is the latter's letter and two blood counts

Feb 16, 1914 I enclose you the blood count—very typical I return you the other The two things of importance are (1) the prognosis—the ultimate outlook is bad Hemorrhages recur, with or without attacks of anæmia (2) As to the treatment Nothing that I know has any influence on permanently reducing the spleen The removal of the spleen is followed by permanent cure Operation, of course, is not without risk. The results depend very much upon the

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surgeon, but nowadays the mortality from the operation is becoming less and less. I do not think the petit mal would contraindicate in any way the operation

January 20, 1914 Differential count Polymorphonuclears, 65 per cent, monomorphonuclears, 30 per cent, transitionals, 3 per cent, eosinophiles, 2 per cent. The leucocytes are few in number, from which one infers that there is a leucopenia. The red blood-cells show no abnormality in size, shape or staining reactions. The blood picture, in view of the clinical facts given, is compatible with a diagnosis of splenic anæmia in an early stage.

February 15, 1914 Red cells, 5,100,000 per cmm hæmoglobin, 85 per cent, color index, 8, leucocytes, 3750

Differential count Neutrophiles, 74 per cent, small lymphocytes, 75 per cent, large lymphocytes, 125 per cent, large mononuclear, 30 per cent, eosinophiles, 25 per cent, mast cells, 5 per cent. The red cells are regular in size, shape and staining reactions. No nucleated red cells and no myelocytes were seen. The films show a marked scarcity of white cells.

Operation was difficult, as there were many adhesions of the upper pole The liver was perhaps a little harder than normal, but there were no definite signs of cirrhosis Stomach and gall-bladder normal The spleen weighed 2 pounds 4 ounces It was examined in the Pathological Department at London Hospital and the following is the report

Fibrous hypertrophy of pulp with trabecular hemorrhages in the spleen Banti's disease March 21, 1914

There has been no further hemorrhage and his doctor writes as follows "He has been living the life of a gentleman farmer and is in excellent health. Lately he has had to take an active part in hard manual work, owing to the shortage of labor, and he has been able to do it in a wonderful way"

Case II —The second was a male, aged twenty-eight, whom I was asked to see as a case of chronic gastric ulcer, with a view to operation

Five years previously he had had pain after food for a few weeks In September, 1915, he had a profuse and painless hæmatemesis followed by melæna. He was in bed for five weeks and remained well until February 27, 1916, when he again had hæmatemesis which continued for over a week. When I saw him he had been ten weeks in bed and was recovering

On examination there was an obvious splenic enlargement His blood examination, April 1st, showed Red cells, 3,270,000, hæmoglobin, 55, color index, 08, leucocytes, 2200, poly neutrophiles, 545, poly eosinophiles, 5, small lymphocytes, 23, large lymphocytes, 15, large hyaline, 6, coarse basophile, 1 Wassermann negative

I diagnosed splenic anæmia and on May 9, 1916, performed splenectomy Stomach, duodenum and gall-bladder normal, liver firm but not cirrhotic Spleen weighed one pound

Pathological Report - Fibrosis of pulp of spleen

He made an excellent recovery and on May 22nd the blood examination showed Red cells, 6,387,000, hæmoglobin, 90, color index 07, leucocytes, 7,800, poly neutrophiles, 72, poly eosinophiles, 0, small lymphocytes, 16, large lymphocytes, 75, large hyaline, 4

# SPLENECTOMY

He has had no further symptoms and remains in perfect health

Case III—The third case of this nature was a girl of twenty-one who had been known to have an enlarged spleen for fourteen years Two years previously she had had severe epistaxis and in October, 1915, sudden profuse hæmatemesis. Six weeks before admission to hospital she had another attack, followed by a further one a few days later. She was admitted to the London Hospital May 27, 1916, six days after the most profuse bleeding she had had. On examination the spleen and liver were both enlarged, ascites was present.

The blood examination was as follows Erythrocytes, 1,990,000, hæmoglobin, 20 per cent, color index, 05, leucocytes, 2000, poly neutrophiles, 53 per cent, poly eosinophiles, 0, small lymphocytes, 32, large lymphocytes, 12, large hyaline cells, 3 One normoblast seen Wassermann negative

Seventeen pints of fluid were withdrawn by tapping

I saw her, with a view to splenectomy This I did on June 13, 1916 The stomach, duodenum and gall-bladder were normal, but the liver was large and cirrhotic The spleen weighed 1 lb 9 ozs

Pathological Report —General sclerosis of spleen with periarterial hemorrhages

She made an excellent recovery and on July 29th the blood examination was as follows Erythrocytes, 4,687,000, hæmoglobin, 55 per cent, color index, 06, leucocytes, 3200 Rouleaux formation very poor Poly neutrophiles, 425, poly eosinophiles, 4, small lymphocytes, 31, large lymphocytes, 165, large hyaline cells, 5, coarsely gran basophiles, 1, poikilocytosis

On June 11, 1917, I saw her apparently in perfect health. She expressed heiself as never having been so well in her remembrance. Seven weeks later she died of sudden profuse hæmatemesis. Unfortunately there was no post-mortem examination.

These three cases taken together are instructive. They are in order of severity. The first two undoubtedly splenic anæmia, the last the terminal stage of Banti's disease.

In the first patient the blood changes are almost confined to the leuco-pænia, in the second leucopænia is more marked, and there is an increase in the lymphocytes with diminution in red cells and hæmoglobin. In the third all these changes are prominent

The result of splenectomy was to restore the condition of blood to nearly normal in fourteen days in No 2, but in the last patient, although her red cells showed marked improvement, leucopænia and lymphocytosis remained Unfortunately, no blood examination was made later than six weeks after her operation

In the other cases in whom no hemorrhage had occurred the blood changes before and after operation were equally striking. All remain in perfect health and have had no hemorrhage. The following is an example

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Case IV.—A B, aged twelve, was admitted to the London Hospital, June, 1914, with spongy gums and a tendency to bruising. His spleen was then noted to be enlarged. Four months later he was readmitted with ascites and I was asked to see him with a view to splenectomy.

The abdomen was full of fluid, the spleen reached to the umbilicus Wassermann was negative Blood examination, November 16, 1914 Erythrocytes, 4,300,000 per cmm, hæmoglobin, 75 per cent, color index, 08, leucocytes, 2300 per cmm Stained blood Polynuclear neutrophiles, 54 per cent, polynuclear eosinophiles, 2 per cent, small lymphocytes, 20 per cent, large lymphocytes, 20 per cent, large hyaline cells, 4 per cent

I operated November 30, 1914 Large amount of ascitic fluid with a large cirrhotic liver Spleen weight 19 ounces

Pathological Report — Fibrosis of reticulum of pulp of spleen Hemorrhage and slight deposit of iron pigment in and around adventitia of vessels close to malpighian bodies

There was some re-accumulation of fluid during convalescence, but, during his last week in hospital, which he left December 23rd, the circumference of his abdomen diminished two inches. On December 12th his blood was practically normal. Blood examination, December 12, 1914. Erythrocytes, 4,800,000 per cmm, hæmoglobin, 80 per cent, color index, 08 per cent, leucocytes, 5000 per cmm. Stained blood. Polynuclear neutrophiles, 75 per cent, polynuclear eosinophiles, 25 per cent, small lymphocytes, 5 per cent, large lymphocytes, 85 per cent, large hyaline cells, 85 per cent, transitional neutrophiles, 05 per cent.

He has been in perfect health since and now (nearly four years after operation) is an engineering apprentice

Giffin 2 reports that of 24 survivors out of 27 operated on at the Mayo Clinic 2 died of hemorrhage a year and five and a half years after operation, and that in 3 others hemorrhage at different periods after operation occurred I know of two similar cases that have occurred in the practice of other surgeons

All cases of splenic anæmia should be operated on early When cirrhosis of liver has supervened, although the patient may be restored to apparent health, fatal hæmatemesis may suddenly occur

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### SURGICAL ASPECTS OF RIGHT SUBPHRENIC ABSCESS\*

## By Joseph Burke, M D or Buffalo, N Y

ATTENDING SURGEON TO THE SISTERS' HOSPITAL, CONSULTING SURGEON TO THE EMERGENCY HOSPITAL

For the purpose of this paper subphrenic abscess is understood to be a circumscribed collection of pus beneath the diaphragm and in contact with some portion of it, usually between the diaphragm and the upper surface of the liver

I have purposely confined my remarks to a consideration of subphrenic abscess situate to the right of the falciform ligament of the liver, for my experience with left-sided abscess has been too limited, confined to two cases only, while on the contrary I have observed eighteen cases of right-sided abscess. The consideration of this experience of eighteen cases will form the basis of my paper, a clinical analysis from a personal standpoint

The falciform ligament plays a very decided part in subphrenic abscess, for it is the dividing line of the subphrenic space, cutting it into right and left areas, the right being bounded above by the diaphragm, below by the liver, and on the left by the suspensory ligament, the transverse colon and its mesentery form the lower border, the colon and adjacent omentum adherent to the parietal peritoneum being firm seldom permits the abscess to perforate into the general peritoneal cavity. Clinically the causes of abscess on the right of the ligament can be traced to infectious processes in the liver, gall-bladder and ducts, duodenum and appendix

It is frequently stated that the majority of subphrenic abscesses contain gas, the term pyopneumothorax subphrenicus was introduced by Von Leyden to describe this form of abscess. In passing I will state that in our whole series of eighteen cases there was not one of them that contained gas, and this is the rule in right-sided subphrenic abscess, though the late Alex Johnson and others asserted the contrary

In our eighteen cases there were seven subsequent upon acute perforation of the appendix, two cases were due to perforation of duodenal ulcer, one due to perforation of gastric ulcer, four cases of gall-bladder infection, one to cancer of the stomach and one to trauma. In the remaining cases unknown Subphrenic abscess following appendicitis may occur in four ways (1) As a result of general peritonitis, (2) direct extension up the lumbar peritoneal fossæ from the pelvis, (3) through the medium of the portal vein, pyelophlebitis, (4) lymphatic extension either up through the retroperitoneal tissue or up the lymphatics around the deep epigastric artery to the falciform ligament

Symptomatology and Diagnosis —Generally speaking, subphrenic abscess

<sup>\*</sup>Read before Steuben County Medical Society, Corning, N Y, May 28, 1918

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was a clinical larity up to 1845, when Barlow drew attention to it. Volkman, in 1879, was the first to operate for it, and Von Leyden in 1880 made the first diagnosis of subphrenic gas abscess, his memorable monograph in which he described the differential diagnosis of pyopneumothorax subphrenicus is a milestone in the history of medicine and surgery. In all the modern text-books of diagnosis Von Leyden's work is quoted and nothing new has been added to our knowledge of the diagnosis of subphrenic gas abscess since that time, though very recently from the clinic of Franz Herzog in Pozony there came a brand new observation, namely. When the patient sat up there was dulness in the epigastrium while in the horizontal position the note was tympanitic. In pyopneumothorax above the diaphragm, the change in percussion notes is confined to the thorax alone and does not reach the abdomen as in subphrenic gas abscess.

In nearly every article that I have read concerning subphrenic abscess there is a woeful lack of details in the description of the physical signs that existed in the personally reported cases, in fact it would lead one to infer that the diagnoses were made from suspicion only, not from definite char-Apropos of this, in the 1918 year book of surgery, the acteristic signs editor laments the lack of team work between the internist and the surgeon, stating that if there were greater cooperation between these two, the early diagnosis and treatment of subphrenic abscess would be the rule and the mortality less There is no domain in surgery where it is all important that the surgeon be the master of the principles of physical diagnosis, as in a case of subphrenic abscess In many cases diagnosis is not difficult, in others There is no other affection that requires so complete a history and thorough and orderly an examination as subphrenic abscess I have analyzed every case that has come under my notice of subphrenic abscess and there stand out two striking points that I have almost invariably observed and upon these points—everything else considered—I have made my diagnosis

- (1) An irregular line of the upper border of the liver dulness, the highest point of this dulness being in the midaxillary or anterior axillary line—in other words, the dulness is not the uniform parabolic dulness found in pleurisy or empyema, but irregular and triangular with the apex of the triangle upward in the midaxillary or anterior axillary line
- (2) The respiratory mobility of the diaphragm in all of my cases, with one exception, was preserved, in that case there was a complicating serous effusion in the pleura. In all of our cases which were due to appendicitis there was a uniformly typical picture, that which first elicited our attention that something was wrong in the convalescence was the fact that there was a slight elevation of the evening temperature, varying from 101½° to 99° in the morning, with the pulse rate correspondingly increased, and, strange as it may seem, respirations were not in every case increased. Instead of the patient showing progress in well-being after an operation for appendicitis, there would be an absence of appetite, coated tongue and, as the case

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progressed, increasing anæmia-in other words, a slowly developing picture of suppuration in some part of the body It has been said that the complete absence of cough and expectoration characterizes subphrenic abscess, in my observations there has been a slight, short, painful irritating cough in a great many of our cases Von Leyden lays particular stress upon the absence of cough and expectoration in the differential diagnosis of gas abscess from pneumothorax As the case goes on the appendicitis operation wound is looked at and found healthy, physical examination of the patient shows a slight rise of the diaphragm on the right side, these signs attract our attention to the subphrenic space, repeated examinations show increasing physical signs, and, when the abscess is frank enough, I have found in my There is a slight increase in the right lower cases the following signs chest dimensions, the left side of the chest moves more than the right side, there can be mapped out a triangular dulness which merges with the liver dulness in the midaxillary line, the apex of this triangle or sharply convex area of dulness is in the midaxillary or anterior axillary line, there is usually a striking differentiation from the pulmonary resonance be present in the abscess, there is pulmonary resonance, next tympany, and The respiratory mobility of the upper line of dulness then liver dulness in the cases that I have seen has been preserved, though somewhat arrested it was never entirely absent

Right here is the place where we can discuss the diaphragm phenomenon, that is, whether the excursions of the diaphragm are interfered with when subphrenic abscess is present. In the normal individual the diaphragm phenomenon can in many cases be determined by inspection, moving downward with every inspiration and upward with expiration—the so-called Litten's sign. In the cases of subphrenic abscess that I have observed, Litten's sign was present in one case only. Again, in the normal individual the mobility of the diaphragm can be always demonstrated by percussion.

The respiratory mobility of the upper line of dulness in subphrenic abscess, that is, the respiratory mobility of the line where the pulmonary resonance ends and the dulness of the upper limit of abscess begins, in all of my cases with but one exception was preserved Whether this can be designated as the mobility of the diaphragm, I cannot say that this lowering of the line of dulness in deep inspiration is caused by the filling in of the costopleural sinus by the lung itself and gives us the percussion phenomenon of mobility of the line of dulness and cannot be interpreted as a measure of active phrenic movement Hoover made a correct observation of a case of subphrenic abscess in which he says that his sign was the determining factor in the differential diagnosis between empyema in the chest and subphrenic abscess in a case in which he diagnosed subphrenic abscess and found it to be correct upon operation He found "that the costal border of the affected side had a greater lateral excursion than the sound side, due to the loss of the normal antagonism of the diaphragm to

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the action of the scaleni and intercostals of the affected side. This sign indicated to him an upward displacement of the diaphragm."

In the cases of pleurisy with effusion or empyema the line of dulness does not vary with inspiration or expiration, due to the filling up of the pleural sinus with fluid, to the presence of adhesions in some cases, to the temporary compensatory enlargement of the opposite lung and to the usual pain in pleurisy In subphrenic abscess, however, there is a different hypothesis, the lung of the affected side although pushed up by the diaphragm is compressed but very little (except in gas abscess where it may be pushed up as high as the second rib and in such a case there is usually a complete paralysis of the diaphragm on the affected side) and hence in deep inspiration the pleural sinus is filled and the upper line of dulness in subphrenic abscess moves downward with inspiration To determine whether the diaphragm moves downward with inspiration in subphrenic abscess or in pleurisy with effusion or empyema, besides percussion we need only to palpate the lower border of the liver to see whether it moves with respiration the liver moves downward with inspiration we are certain that the diaphragm moves downward with inspiration. This may be due to the filling of the costopleural angle by expansion of the lung in deep inspiration the diaphragm moves downward of itself with inspiration in subphrenic abscess, I cannot prove, because it has been demonstrated that in acute infections of the abdomen, particularly in cases of appendicitis, the diaphragm movement of itself becomes somewhat arrested, in some cases fixed, and its movement is a passive movement if it exists at all I interpret, therefore, the mobility of the upper line of dulness in subphrenic abscess by inspiration as not an active diaphragm phenomenon, but as due to a filling of the costopleural sinus by expansion of the lung in deep inspiration

Recently Major Sayle, MRC, suggested the limitation of diaphragm movement in acute appendicitis, this is worth investigating, particularly from an X-ray standpoint. In many cases the liver becomes adherent to the chest wall and in these cases the liver is not pushed downward, nor does it move with respiration. In massive effusion into the right pleura the liver is found pushed downward and the heart pushed to the left. In subphrenic abscess I have seen the heart's area encroached upon twice, and I have seen the liver pushed downward in right subphrenic abscess so much that in one case the diagnosis was made, by another physician, of acute cholecystitis or pericholecystitis. It was very recently demonstrated in some of my cases by the X-ray that after recovery from subphrenic abscess the diaphragm moved upward and downward with respiration, though it seemed to the radiologist that the excursions were limited

In some cases there is heard early in the disease perihepatic friction sounds, but I have observed no appreciable difference in the fremitus nor any difference in the normal auscultatory, phenomena, though compression of the right base is often found. In two cases I have found the heart displaced,

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in some of our cases the liver has been pushed downward, and pressure upward directed against the lower border of the liver caused pain

In about one-half the cases of subphrenic abscess in general, the onset is sudden, in the other half insidious. In cases of sudden onset the cause is usually a perforation of a hollow viscus,  $e\ g$ , the duodenum or stomach. Pain is the rule in the acute occurring abscess, and this is referred

generally to the point of pus formation

In the insidious cases, pain is not the rule When pain occurs in acute perforation it is usually the severe, stabbing pain of peritonitis

Vomiting occurs very frequently as a symptom, perhaps in about onethird the cases, and when it is present it is usually severe, uncontrollable and due to the localized peritonitis consequent upon an acute perforation of the stomach or duodenum In our cases vomiting occurred in two and was due to duodenal perforation and peritonitis. The vomiting was the most prominent and persistent symptom in these two cases

Hiccough is sometimes observed In our cases it occurred once, only Localized swelling in the abdomen is sometimes observed, but this occurs somewhat late in the course of the disease. Swelling just below liver margin occurred in one of our cases Over this area of swelling, pain was present upon pressure Given a picture of such a febrile illness, as above described, following some abdominal disease, whether in the upper or lower abdomen, we must always think of subphrenic abscess as the cause of the trouble, added to this polynuclear leucocytosis and certain physical signs, we can say for almost a certainty that subphrenic abscess is present then justified in using the diagnostic needle to ascertain the presence of pus There are in 33 per cent of the cases of subphrenic abscess, infections of the pleura, coincidently with the abscess or following transpleural operations for the subphrenic abscess. There may be pleural effusion of either pure serum or pus

The site usually chosen for puncture corresponds to the convex dull When the needle enters the diaphragm, the movements of respiration ommunicated to it. This will tell whether the pus is above or below are communicated to it the diaphragm, but will not tell if it is a subphrenic abscess or an abscess of the liver If, when making the puncture, serous fluid enter the needle, we must not assume that a serous effusion in the pleura is the cause of the illness, we must push the needle in farther and, if pus is shown in the needle, the diagnosis of pleurisy with effusion as well as subphrenic abscess is made clear

A word of caution about the needle will not be amiss I use a needle three inches long with good large caliber so that deep collections can be reached. It is obvious that to perforate the diaphragm an ordinary hypodermic needle will not do. If the caliber is not large enough flakes of fibrin will plug the needle and give us a negative result though pus may be present. The needle should be well tempered, cases have been reported in which needles have been broken and lost in the body. Be sure that the needle

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be true, try it out with sterile water before using. When the needle is true and nothing apparently appears in the syringe after plunging and withdrawal, the piston should return immediately after release on account of vacuum, but, if it does not spring back, then gas from a gas abscess may be in the cylinder

Treatment —Subphrenic abscess is a distinctly surgical affection, though a limited number will recover without surgical intervention

This may be accomplished in three ways

First, the pus may become encapsulated between the liver and the diaphragm, rendering the pus sterile and finally causing absorption. I have encountered two instances of walled-off serous exudate, in the right subphrenic space, in cases whose histories would lead one to think of a previous subphrenic abscess. I remember a case of gall-bladder disease in which when the abdomen was opened, in the upper right rectus line, there was found a pure serum, totally encapsulated, reaching and occupying the right subphrenic space. At the time of operation I speculated as to the probability of subphrenic abscess whose solid elements had been absorbed not unlike we find in cases of hydrosalpinx

Second, the pus may rupture into a bronchus and spontaneous cure result. I have seen an undoubted case of this nature in a young man who gave a history of an acute attack of appendicitis with continued febrile illness lasting three months. At the end of the sixth week there occurred the sudden coughing up of a foul smelling pus, this expectoration being copious and extending over a period of six weeks with final apparent recovery. I saw the patient after a second attack of appendicitis and, on account of the rigidity and pain in the right hypochondrium, I made a high right rectus incision so that I could investigate the gall-bladder. Upon opening the peritoneum there escaped about a pint of a clear serous fluid, which had been encapsulated and extended up between the liver and chest wall to the subphrenic space. There was a complexity of adhesions in this case, particularly of the ascending colon, and these findings led me to believe that the man had had a subphrenic abscess complicating his first attack of appendicitis.

The appendix at operation was retrocæcal

Thu d, the pus may evacuate itself spontaneously through the alimentary tract

Fourth, a case has been reported in which the abscess found its way to the umbilicus where it discharged

The mortality in subphrenic abscess is variously placed at between 35 per cent and 55 per cent, whether operated or not

I have carefully reviewed the mortality statistics of operated cases of subphrenic abscess and the percentage coincides with my own personally observed cases. It is a most discouraging fact that about 50 per cent die after operation. In my judgment the reason for this discouraging mortality is twofold.

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First, the lack of proper and early diagnosis, and,

Second, the inappropriate method of surgical attack in the individual case. It is not every case that responds to transpleural operation, nor abdominal operation, nor a combination of both. I earnestly believe that every case of subphrenic abscess should be a law unto itself, the etiological factor and the anatomic situation being the determining factors

In the cases of death in my own series, I have always wished—post mortem—that I had made a different attack in every case, in all of them I operated transpleurally Had I analyzed every individual case as to the causal factor and operated accordingly, I am sure that my mortality would have been less. It is not alone necessary to say that pus is present in a given case, but we must localize it if possible, according to our knowledge of the divisions of the subphrenic space and the etiological incidence

Therefore, in my opinion, based upon the mortality statistics gleaned from a none too copious literature and from my own series of operated cases, it is necessary to make every case an individual one, we must apply no fixed rule for operative attack, but, judging from the etiology and the anatomic situation of the abscess, as well as its extent, we must determine whether the operation should be done transpleurally, abdominally or by a combination of both methods I will analyze some of my own personal fatal cases first, that is, those cases that died after operation My first postmortem regret was after subphrenic abscess following a case of gangrenous appendicitis in a child of eight years I operated transpleurally for the subphrenic abscess with the prompt formation of an infected pyopneumothorax with subsequent death Had I attacked through the original appendix wound and found the abscess from below, I would probably have saved my patient. In contradistinction to this, I had a case of a boy of thirteen years on whom, some fifteen days previously, I operated for perforated appendix and general peritonitis in whom sudden symptoms of complete obstruction of the bowels asserted themselves, due to a large accumulation of pus which found its way up along the ascending colon to the subphrenic space I attacked this abscess through the original appendix incision and immediately tapped a large abscess whose upper limit was the diaphragm, this was abundantly proved by the fact that I inserted a large drainage tube which reached his diaphragm, causing uncontrollable singultus until the tube was partly withdrawn

This case recovered, the bowel obstruction disappeared simultaneously with the evacuation of the abscess

I will relate somewhat in detail the histories of a few more cases that have been highly instructive to me and I hope will be of value to others. The first case is a subphrenic abscess following acute gangrenous appendictis. The patient made a splendid appendix operative recovery, the day after his operation he felt apparently well, temperature was normal but the pulse did not return to its normal plane, there was a drain in this wound which was dressed daily. The patient complained

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of no pain but a slight short, sharp irritating cough at night temperature in the evening would be up slightly, sometimes 991/2° (highest 101°), the patient's tongue remained coated, appetite was absolutely nil, food had to be forced upon him, he remained in the hospital three weeks, always having a little temperature and cough, and I suspected that he had an infection beneath his diaphragm the house surgeon to make a leucocyte count and he reported to me the blood count was normal, and the signs I had found indicating subphrenic abscess were so slight and the reported blood picture normal and the patient up and around, the appendicitis wound healed, I did not feel justified in putting the needle in About three weeks later I was called to see this patient, who told me he' was not getting along as well as he expected, I examined him and found every evidence of right subphrenic abscess, the needle proved the presence of pus, and at operation, which I did the same day, transpleurally, I emptied about a quart of pus from beneath his diaphragm

There was one case in which there was displacement of the apex beat, marked cyanosis and dyspnœa particularly noted upon change of position of patient following early operation for perforation of duodenal ulcer. In this case the displacement of the apex beat, the dyspnæa and cyanosis were undoubtedly due to the large accumulation of pus which encroached upon, the cardiopulmonary areas, due to the fact that the abscess had existed seventeen days without recognition

M T, aged twenty-two years Entered hospital with perforation of duodenal ulcer Immediate operation, after operation there was elevation of temperature and on the seventh day the patient began to cough and expectorate On the tenth day the cough became frequent and expectoration copious On the seventeenth day after the operation, he complained of pain in the right side. On the nineteenth day, the temperature was 104°, and patient coughed very frequently when changing position

Physical examination. Patient prostrated, lips cyanosed, there is frequent cough with copious expectoration, labored breathing, the lower right chest bulging, the intercostal spaces obliterated, measurement of each thorax half shows a difference of one inch of the right larger than the left, apex beat cannot be seen and seems diffuse upon palpation in the left mammary line

Percussion The upper border of liver dulness begins in the parasternal line at the upper border of the sixth rib. In the mammary line of upper border sixth rib, axillary line of upper border sixth rib, respiratory mobility present. Above the line of liver dulness there is harsh inspirium, somewhat prolonged expirium, fine râles at the end of inspirium, liver extends laterally to the left mammary line and extends about two finger breadths below the costal border, needle introduced into the axillary line showed pus. Diagnosis. Subphrenic abscess

I will report another case of a young man (J B), nineteen years of age, who was sent into the hospital on account of an acute illness that began three and one-half weeks previously, in which displacement

### RIGHT SUBPHRENIC ABSCESS

of the apex beat was present. The patient complained of slight pain to the right of the epigastrium which radiated to the right side beneath the ribs, pain also went to right shoulder. The pain at first was mild, but soon became so bad that the patient was unable to get out of bed. He coughed about a week before he was taken with this pain, but has not coughed during the present illness, feels weak, short of breath, has no appetite

Temperature upon entrance to the hospital, 100°, pulse, 100, respiration, 20

Physical examination showed the patient emaciated, lips cyanosed This is the second case of subphrenic abscess in which cyanosis was observed. Tongue red, dry, slightly coated. Apex beat diffuse. Point of maximum intensity in fifth interspace in mammary line, showing displacement of nearly one inch to the left. Lungs are normal except in the right lower portion, where compression breathing is noted above the line of liver dulness. There is marked bulging noted in lower chest. Percussion revealed following. (1) At parasternal line liver dulness begins at upper border of fifth rib. (2) Mammary line, upper border of fifth rib. (3) Anterior axillary line, upper border of sixth rib. (4) Midaxillary, seventh rib. (5) Post-axillary line, at eighth rib. Litten's phenomenon noted on both sides of chest. Liver dulness extends about three finger-breadths below margin of ribs. Liver pushed toward left and involving Traube's space.

Respiratory mobility all along line of liver dulness Needle inserted in eighth intercostal space in midaxillary line and pus demonstrated

The history of another case ought to be related for the reason that four consecutive false diagnoses were made by four different physicians who saw the patient at various intervals during his illness, it will show how the signs and symptoms of some cases of subphrenic abscess are variously interpreted A male Italian thirty-five years of age, whom I first saw on the forty-second day of his illness, the first consultant who examined the patient with the family doctor made a diagnosis of duodenal ulcer, which in my mind was absolutely correct at the time of his examination, and his diagnosis was the foundation of our diagnosis made on the forty-second day of his illness diagnosis of right-sided pneumonia, pleurisy with effusion, unresolved pneumonia and tubercular infiltration of the lung were by various consultants subsequently diagnosed I examined the patient on the forty-second day of his illness and was able to demonstrate to his family physician this triangular cupping of the upper line of dulness with the apex in the midaxillary line and the respiratory mobility of the diaphragm markedly preserved, showing conclusively that there existed a subphrenic abscess. The diagnostic needle and the operation proved the correctness of the diagnosis. It is strange that these patients, as in this case, can in the beginning be so desperately ill and after a time seemingly improve, get around upon their feet with very little evidence of the gravity of the nature of the illness It was thought that this patient was improving because he was able to be up out of bed His tongue when I saw him was dry brown, pulse 96, temperature

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99° and blood count 19,000 An earlier diagnosis in this case would undoubtedly have saved the patient's life. I operated transpleurally, found the abscess, introduced suitable drain, but the patient succumbed on the fifth day. I believe in this case that had I used a combination transpleural-abdominal attack, the chances for recovery would have been enhanced.

I will report another case which will illustrate that a patient may have a subphrenic abscess and at the same time pleurisy with effusion A city fireman, thirty-five years of age, consulted me in March, 1913, he gave a history of typical periodic gall-bladder attacks months later I saw him in consultation. The patient was taken suddenly with great pain in the right hypochondrium, and thereafter developed a febrile illness with cough On the twenty-first day a needle was inseited between the third and fourth ribs in the right midaxillary line, a pure serum was obtained The pleura was aspirated and about a pint of serum was removed, there was no change in the patient's condition, however, and the day following the aspiration of the pleura I saw the patient in consultation account of the history of gall-bladder disturbances previous to the last illness, the abdominal origin of the present illness, the convex area of liver dulness with its apex in the midaxillary line and a marked tenderness over the gall-bladder region made me suspicious of subphrenic abscess. The diagnostic needle and open operation demonstrated the existence of an abscess beneath the diaphragm case transpleural operation was done by another surgeon, the abscess demonstrated I believe that had the combination method—that is. transpleural-abdominal method—been used, his chances would have been better

Another case that I wish to dwell upon is that of a young man, twenty-five years of age, who spent ninety days in the hospital after an operation for diffuse peritonitis following appendicitis. After the appendix operation with drainage the patient made an apparent recovery until the eleventh day His pulse was down, temperature normal morning and evening, but his appetite did not return, his tongue remained coated and he became anæmic in spite of the fact that according to the chart he was improving On the eleventh day he complained of a dry, irritating, painful, unproductive cough, his temperature began to go up, pulse increased and he progressively grew worse The appendix wound healed, there was nothing in the abdomen that could be demonstrated to account for his temperature Repeated daily examination made me suspicious of subphrenic abscess. The physical signs were so indefinite in the beginning that I did not feel justified in using the needle The following morning the lower border of the liver was tender to pressure, moved with respiration, but in the right midaxillary line there was an elevation of the liver dulness. I inserted a needle and pus was found present, I did a transpleural operation and from this the young man seemed to be making a good recovery until about the twelfth day, after when the temperature again began to become elevated The young man began to show evidence of more infection, the tube in

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the subphrenic abscess cavity was free and draining and examinations showed evidence of pleural involvement, the needle brought pus, resected another rib and emptied the pleura. The patient began to improve for several days and then the temperature began another ascent and the patient developed lung abscess, which I opened through the incision already made in the pleura, he was in desperate condition and at one time on the operating table we all thought he was dead. He recovered from the operation and the day following he developed an acute lobar pneumonia, which lasted seven days and ended in a definite crisis, and from that day the patient made an uninterrupted recovery. He was ninety days in the hospital from the day of the operation until the day he left. During that time he had an operation for perforated appendicitis with general peritonitis, subphrenic abscess, empyema and pulmonary abscess and then went through a typical lobar pneumonia

The last case I saw recently in consultation with Doctor Stumpf Mrs C M was first taken sick suddenly with rather severe vomiting, followed next day by a watery brownish diarrhea. About one-half dozen movements a day, cleared up under treatment, constipation followed. Temperature ran from 101° to 102° (continuous fever). This lasted about three days. I saw her on the sixth day of her illness, she complained of such severe pain in epigastrium and was hardly able to breathe. Following this attack, temperature down to normal, running from 97° to 100°, pulse about 80. Patient still complained of steady pain along border of ribs, right side. Blood count showed 25,000 whites, differential, 80 per cent polymorphonuclears, hæmoglobin, 65 per cent.

Physical Signs - Patient pale, dyspnæa, flushed Alæ nasi visibly active on inspiration and expiration. Apex beat, normal uniformly distended, painful swelling in right hypochondrium in anterior axillary line Percussion, left side of chest normal, heart area Right side—Liver dulness begins in parasternal line upper border fifth rib, mammary line upper border of sixth rib, midaxillary line upper border of sixth rib, normal dulness beyond midaxillary line posteriorly Above line of dulness some indistinct râles at end of inspirium, also heard during expirium, over the area of dulness, no breathing sounds audible Liver—Lower border extremely tender on palpation, pressure caused excrutiating pain, marked when tried to outline costal border Respiratory mobility present, though somewhat Needle inserted in midaxillary line between seventh and eighth ribs, also ninth ribs, each time brought a thin, watery, sanguinous fluid (under pressure) Temperature, 101°, pulse, 84, respiration, 20, when patient entered hospital Just before operation, temperature 100°, pulse 92, respiration 28, patient given 1/6 grain morphine at 12 P M, previous to operation, and patient rested comfortably Tongue clean, moist, no coating

Operation—June 2nd, 10 AM Dr Jos Burke, assistant, Doctor Stumpf Dr O Rebeschei, anæsthetist Upper right rectus incision about ½ inch from its right border As soon as peritoneum was opened, a yellowish, greenish pus freely exuded Enlarging the incision

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upward, the falciform ligament could be beautifully seen forming the left boundary of the abscess cavity. Careful sponging brought out pus and as adhesions were gently separated up over the liver and right abdomen, about a pint of thin, watery, sanguineous fluid exuded. Sponge inserted under liver toward foramen of Winslow also brought yellowish, green pus in abundance. A sponge was also introduced between the liver and chest wall to mop out that cavity. About 9 inches of sponge holder inserted until it came in contact with the diaphragm. After dry mopping a Mikulicz drain introduced down to foramen of Winslow and another inserted between liver and chest wall to diaphragm. Incisions closed above and below drains. Recovery

In concluding this paper I would like to state that the very earliest diagnosis of subphrenic abscess is all important to the success of operation. The longer the case remains unidentified the poorer are the chances for recovery. In cases that are frank, that is, where the accumulation of pus is large, the prognosis is good. Where there is a case of suspected abscess beneath the diaphragm, I advocate unhesitatingly the free use of the diagnostic needle, one that is sufficiently long, with good caliber. If gas is present do not be disappointed if the needle shows no pus upon the first introduction, but plunge again, a rib space lower, perhaps persistency will reward the effort.

In regard to the choice of method of operation, personally I always attack by the abdominal route as in my last case, and if necessary, combine it with the transpleural route. In this last case, I noticed particularly how well the falciform ligament guarded the general peritoneal cavity from extension of the suppurating process. It is possible that many of the fatal results after transpleural operation were due to multilocular abscesses, one only of which was reached through rib resection, while in the abdominal method a second abscess would scarcely be overlooked

# HYPERNEPHROMA OF THE FALCIFORM LIGAMENT OF THE LIVER

### By Anthony H Harrigan, M.D.

of New York

ABSOCIATE VISITING SURGEON, FORDRAM HOSPITAL

Acting upon the advice of Cullen that surgeons should publish their unique cases, the following history is presented

Female, aged thirty-five years, married, one child The family history is negative. The personal history is of no interest, save that the patient has had a large parenchymatous goitre for several years.

Present Illness —During the past two years, patient has suffered from severe abdominal pain in the right upper quadrant. This pain is intermittent in character and does not radiate. It is referred chiefly to the region of the gall-bladder. There have been no typical attacks of biliary colic. No jaundice. At times the attacks are combined with severe vomiting. The attacks may last several days. Menstrual history normal. Urine examination negative. Vaginal examination revealed an anteflexed uterus. No adnexal disease. Diagnosis. Chronic appendicitis and possibly cholecystitis.

Operation (Misericordia Hospital, July 11, 1917) —Morphine-ether narcosis A right rectus incision. The appendix was long and thickened. Appendectomy by the ligation method. The gall-bladder and the biliary ducts were negative for stone. A small mass, about the size of a walnut, was felt in the falciform ligament, close to the free border of the liver. It was readily removed by enucleation. Rather active hemorrhage took place following its removal, which was readily controlled by suturing the round ligament to the surface of the liver. The stomach and duodenum were negative for ulcer. Abdomen closed in layers. Uneventful recovery, with primary union of the wound. The patient was discharged from the hospital July 24, 1917. Has been in excellent health since.

Pathological Report (by George Hohmann, M D) —The greater part of the specimen consists of a delicate reticulated stroma, embedded in which are numerous variously sized, mostly large, somewhat spheroidal and oval cells containing a large nucleus, surrounded by granular cytoplasm. Here and there are collections of lymphoid tissue. The blood-vessels are few, their walls thickened, with one or two containing a hyaline plug. Diagnosis. Hypernephroma. The specimen was also examined by George Rohdenburg, M.D., who concurred in the diagnosis.

An analogous case, bearing the same title, was reported by Starr in Annals or Surgery, September, 1917 The tumor, in that instance, measured 20 cm in diameter and weighed eight and one-half pounds. It lay between the folds of the falciform ligament. The case report, though

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purely casuistic, calls attention to the rarity of the condition and refers briefly to the embryological origin of the tumor

The subject of hypernephroma is of interest in this connection, from an ontogenetic viewpoint From the study of embryology, it is known that the cells of an organ undergoing development may be snared or included by an adjacent tissue or organ This phenomenon of misplacement, or abnormal situation, is called heterotopy. The kidney, the adrenal, the ovary and the testicle manifest this heterotopic tendency to a marked degree It is assumed that the basis for this phenomenon lies in the close and common origin of these organs from the Wolffian body and ridge, proximity and contiguity favoring the accidental cell inclusion. It is probable that the primitive shoots of the embryonic blood-vessels transport the cells The adrenal, of all organs, forms the most striking example Adrenal rests are mainly found in the kidney and the liver. It is interesting to relate that this genetic aberration of the adrenal manifests itself, at times, in a bizarre manner, for adrenal rests have been found in the broad ligaments, in the pampiniform plexus, and in the semilunar ganglion. As is well known, the thyroid, the spleen, and the ovary have, at times, secondary glands, but even in these instances, the secondary glands are usually close to the parent organ In passing, it may be stated that even accessory livers have been reported

The subject of adrenal rests in the kidney is a debatable matter. Wilson holds, in marked contradistinction to Grawitz, that these so-called adrenal rests are really remains of the Wolffian body. The crucial point in the theory advanced by Wilson is that the tumors of the kidney described by Grawitz as hypernephroma have their origin in strands of nephrogenic tissue. These views are essentially theories. They are susceptible to argument. In sum, there are three interpretations of the hypernephroma of the kidney. The theory of Grawitz, that the tumor rises from an adrenal rest, the theory of Stoerck, that they are formed by proliferations of the secreting epithelium, and the theory maintained by Wilson, as above enunciated

No doubt exists in regard to the occurrence of adrenal rests in the liver. They are by no means unusual and their presence is clearly explained on embryological grounds. It is a matter of histological demonstration that at one time during the development of the embryo, the adrenal cortex is in direct contact with that of the liver.

In conclusion, though the publication of this case report does not, in any manner, explain how adrenal rests reach, during embryological development, the falciform ligament of the liver, it serves, possibly, to call attention to an interesting pathological condition, important, incidentally, to the surgeon

# THE LOW LATERAL INCISION AND A METHOD OF NERVE BLOCK FOR APPENDECTOMY

# By Leigh F. Watson, M D

OF CHICAGO

Many operators believe that local anæsthesia in appendectomy is adapted only to interval cases in which adhesions have not formed. There are many cases in which the local method cannot be used, however, when it is possible, I believe that next to herniotomy, appendectomy is the most satisfactory of the major operations that are performed under local anæsthesia.

Success depends upon a proper incision and the ability to block the cerebrospinal nerves. When the incision is made directly over the base of the appendix, and the cerebrospinal nerves in the mesocolon are completely blocked before any manipulation is attempted, the operation is much easier than when it is done through a McBurney or the lateral rectus incisions of Battle, Kammerer, Jalaguier and Lennander. I have used this low lateral incision since 1910, in fifty patients who required removal of the appendix, either as an immediate or interval operation.

Anæsthesia for Incision —Any local anæsthesia operation is successful only when it is painless, and too much emphasis cannot be placed upon the necessity of preventing the least pain in acute appendicitis. In this condition all pressure on the abdomen must be avoided. The initial infiltration of the skin should be preceded by ethyl chloride spray so that the prick of the needle is not felt. For additional injections and for the division of the different layers of the incision, the tissues should be held up with sharp-toothed anatomical forceps. It is usually advisable to inject the parietal peritoneum for a distance of one or two inches from the edges of the wound before the peritoneum is incised. Sharp scissors will be found preferable to a scalpel for cutting, because the tissues can be divided with the scissors without making pressure on the hypersensitive abdomen

Incision — The McBuiney and lateral rectus incisions are too far removed from the base of the appendix for the local method. To expose the appendix properly through these incisions necessitates uncomfortable retraction on the external oblique and its aponeurosis. Many writers have noted that in the cadaver the base of the normal appendix is found at McBurney's point, while in the living subject it is below this point, usually on a level with the center of Poupart's ligament. A number of operators have called attention to the ease with which the appendix can be removed when operating for right inguinal hernia. If the incision is made directly over the base of the appendix, slight retraction on the edges of the wound will provide a good exposure, and it is less difficult to keep the small intestines out of the way than when the McBurney or lateral rectus incision is used. With

## LEIGH F WATSON

local anæsthesia, it is not practical to use sponges within the abdomen unless they are required by the presence of an abscess, tympanites, hemorrhage, etc. A point one and one-half inches from the right anterior superior spine,

A point one and one-half inches from the right anterior superior spine, on a level with a line connecting the two superior spines, is selected for the beginning of a vertical incision which extends directly downward for two to three inches, to a point just above and to the inner side of the internal abdominal ring. After incising the skin and subcutaneous tissues, the aponeurosis and external oblique are separated in the direction of their fibres by blunt dissection, which exposes the internal oblique. The inner flap is freed from the internal oblique until the linea semilunaris is reached, usually about one-half inch from the opening in the external oblique. At this point the internal oblique muscle and aponeurosis, and the transversalis muscle and aponeurosis, and peritoneum, are incised parallel to the incision in the external oblique muscle and aponeurosis

Advantages of the Low Lateral Incision —Traction to expose the appendix is avoided, because this incision, in the external oblique and its aponeurosis, the most resistant structures, is directly over the base of the appendix. It can easily be enlarged without weakening the abdominal wall. The illohypogastric and illoinguinal nerves are not injured because the incision lies between them. Opening the external and internal oblique muscles and their aponeuroses at different levels, preserves the gridiron arrangement of these structures and prevents post-operative hernia. When this incision is used there is also less opportunity for the small intestines to crowd into the wound, than when the higher incisions are employed. Cerebrospinal Nerve-Block—In simple appendicitis when the appendix

Cerebrospmal Nerve-Block —In simple appendicitis when the appendix appears in the wound after the peritoneum is incised, infiltration of the meso-appendix is often sufficient to permit a painless removal of the appendix, providing no traction is made at any time. In the majority of cases it is necessary to proceed as follows. The cœcum is grasped gently with moist pledgets of gauze and displaced to one side, usually inward, exposing the mesocolon, which carries the cerebrospinal nerves to the lower part of the ascending colon, cœcum and appendix. A small quantity of anæsthetic solution is injected through a very fine needle at short intervals along the mesocolon for a distance of three or four inches, for the purpose of blocking the cerebrospinal nerves, which are responsible for the sensation of pain that follows traction on the mesentery, and for the separation of adhesions. When the patient states that manipulation and traction are painless, and without the referred epigastric pain which is so characteristic of the usual local anæsthesia appendectomy when only the meso-appendix is blocked, the appendix is located and delivered into the wound. While anæsthesia continues complete, the adhesions are separated, the meso-appendix ligated and the appendix removed in the usual manner. The necessity for gentleness in handling the intestines is important, to avoid accidental traction on unanæsthetized portions of the mesentery.

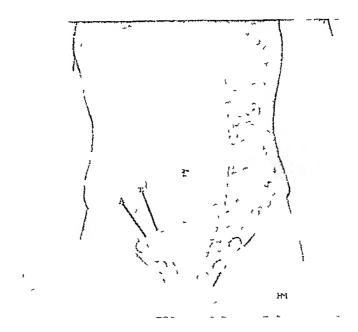


Fig. 1 — Low lateral incision for appendectomy A incision through skin subcutaneous tissues external oblique and its aponeurosis, B incision of internal oblique and transversalis



Fig 2 —Mesocolon nerve block for appendectoms Method of infiltrating the mesocolon to anæsthetize the cerebrospinal nerves supplying the appendix and its mesentery



# SURGICAL PATHOLOGY OF THE HUMAN PROSTATE GLAND

# BY OSWALD S LOWSLEY, M D.

of New York

Before proceeding with a discussion of surgical pathological conditions of the prostate gland it seems appropriate to discuss briefly the embryology and anatomy of that organ

The human prostate gland begins to develop at the third intra-uterine month from five different foci. These foci, as I have shown in a previous communication, originate as solid epithelial outgrowths from the posterior urethra and later from the five lobes of the prostate gland. The solid finger-formed buds later develop lumina which always remain small compared with those of the adult prostate until the great increase in size at puberty. At that time the epithelium, which has previously consisted of cuboidal cells two or three layers thick, becomes cylindrical in type and one layer in thickness, resting upon a felt-work membrane.

The five groups of tubules from which the gland originates become the five lobes of the prostate, namely Anterior, posterior, right and left lateral, and middle lobes. The anterior lobe in early embryonic life is as prominent as other lobes of the prostate, but it usually atrophies about the time of birth. In some cases, as in that of a seventeen-year-old boy in my series, it remains as large and prominent as any of the other lobes, and there are several instances in which an hypertrophy of the anterior lobe tissue has occurred

The posterior lobe is always present and is separated from the middle and lateral lobes by a rather firmly knit lamella of connective tissue in which the ejaculatory ducts are embedded

The two lateral lobes and the middle lobe develop separately, as has been described, but they are not separated from one another by partitions of any sort and from the surgical standpoint their separate origin is of no consequence

The subcervical group of tubules which I have described in detail elsewhere begins to develop at the fourth intra-uterine month and these become of considerable consequence, due to the fact that they grow back just under the mucosa of the urethra and within the sphincter, and, as my studies have shown, they become enlarged in almost 25 per cent of men over thirty years of age. They form several types of tumors at the floor of the vesical orifice, the single tumors of varying sizes, the partially divided tumors and those divided into three portions. This condition occurs probably because of the continual pressure exerted by the action of the so-called Bell's muscles during each urinary act.

The anatomical arrangements of the different portions of the prostate are

### OSWALD S LOWSLEY

of the utmost importance in the various surgical procedures in attacking pathological conditions of the prostate

wilson and McGrath (Sung Gyn and Obstetnics, December, 1911, pp 647-681), in their splendid publication on the "Surgical Pathology of the Prostate," have pointed out many valuable facts. Seven of four hundred and sixty-eight cases were tuberculous, which disease these authors consider to be spread by the blood stream and to occur in the periphery of the lateral lobes. Secondary infections are occasionally present and Halle and Motz hold that surgical interference should not be attempted in cases with acute secondary infection. I agree with Albarran, who states that undoubted always and emphasized experimental experimental and processes of processing the cases of processing the case of processing the case of processing the case of the case of processing the case of chronic inflammation exists in 100 per cent of the cases of prostatic hypertrophy

Harmon and Weigert believe that the prostate is practically always the seat of foci of infection in all cases of pyæmia and septicæmia

#### ACUTE PROSTATITIS

Acute prostatitis is caused in the great majority of cases by the gonococcus There is practically always some involvement of the prostate in every case of posterior urethritis Careful observations by a number of writers on bacteriological studies of urethritis, show that in addition to the gonococcus there may be present Staphylococcus albus, Sereptococcus pyogenus, Colon bacillus, and a slender bacillus not identified Mixed infections of the prostate are not rare

Albarran and Cottet identified the colon bacillus, streptococcus, staphylococcus, and gonococcus in three cases of prostatic abscess

Cohn found Staphylococcus albus present eleven times, Colon bacillus once, a diplococcus twice, and an unidentified bacillus once

The prostate is undoubtedly one portal of entry for septicæmia, and when the gonococcus is the offending organism is practically always the original focus

There are three types of acute prostatitis generally recognized, the most common being acute cararhal inflammation which is always present in acute posterior urethritis, and nearly always caused by direct extension into the tubules by the gonococcus The contiguous organs including the utriculus prostaticus, ejaculatory ducts, and seminal vesicles may be affected at the same time Following the first type the second or follicular prostatitis develops This condition is characterized by the formation of small abscesses, or dilatation of the prostatic tubules with pus which is not emptied from them, on account of some obstruction of the ducts, either due to temporary ædema or other causes

An intensification of the secondary stage develops into the tertiary or parenchymatous prostatitis, in which the small collections of pus become larger, more of the stroma surrounding them becomes involved and finally the entire gland is increased in size, becomes hot, tender and tense, and is liable to disintegrate and form a large clinical abscess of the prostate

# PATHOLOGY OF THE HUMAN PROSTATE GLAND

The treatment of prostatic abscess naturally falls into two classes viz, (a) Non-operative and (b) operative

The non-operative ineatment consists in relieving the retention of unine which frequently accompanies this condition by regular catheterizations with a soft rubber catheter if possible. Warm boric acid irrigations of the bladder are helpful, and upon withdrawing the instrument into the posterior urethra argyrol may be instilled. Very hot rectal douches may be given as often as every four hours, but are usually given twice daily. Some surgeons prefer to insert a so-called "cooling tube" into the rectum in such a manner that it rests upon the prostate. Cold water may then be run through it for one-half hour at a time. A very large percentage of the prostates affected subside without completely breaking down, and this fact is the strongest argument in favor of not operating upon every acute prostatitis. Such conditions should always be accompanied by gentle daily rectal examinations to determine the exact conditions present, as they may alter rapidly

The indications for operative treatment of this condition are (a) Fluctuation in any part of the gland as made out by gentle rectal touch (b) Continued retention of urine (c) Distressing pain (d) Persistent elevation of temperature. In this connection it is worthy of note, that very frequently there is no elevation of temperature whatever, in certain cases which may involve most of the gland.

The operation of choice is the perineal section with intra-urethral rupture of the abscess, being careful to break down the honey-combed arrangement of tissues which usually is present. A tube is then introduced into the bladder which is left in place forty-eight to seventy-two hours, thus draining the urine from the bladder and allowing the pus to discharge around the tube, which is kept in place by one stitch taken in the skin closing the wound not too tightly and being tied around the tube to keep it in place

The intra-urethral evacuation is much preferable to the method which has been recommended by certain surgeons, whereby the posterior surface of the gland is exposed and incised, for the following reasons (1) Drainage is direct in the former and continues during the time the tube is in place and after it is removed, while by the latter method, the pressure of the rectum and levator ani muscle upon the sinus will prevent free drainage (2) In the intra-urethral drainage the elasticity of the capsule of the prostate tends to aid in discharging the pus, while in extra-urethral incision the capsule will tend to close the incision as soon as the drainage tube is removed, and hence interfere with the complete evacuation of pus (3) By the intra-urethral method with a drainage tube into the bladder complete emptying of that viscus is assured, while by the extra-urethral method that fact is not so absolutely assured

Both of these methods of evacuating a prostatic abscess are preferable to a suprapulic operation with an intra-urethral evacuation of the pus into the bladder and suprapulic drainage of that organ

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OPERATIONS FOR SUPRAPUBIC DRAINAGE OF PROSTATIC ABSCESSES

Case	Age	Pre operative diagnosis	Operative findings	Special treatment	Results	Days in hospital	Condition on discharge
ı	50	Abscess of both lobes	No pus	Suprapuble siphonage 5 days Reference catheter 14 days	Wound healthy and dry on thirty-fifth day	40	Cared
8	23	Abscess of both lobes	Abscess of both lobes at vesical junction Much	Suprapubic siphonage 4 days Retention catheter 30 days	Wound healed on thirty- third day	34	Cured
т	75	Abscess involves both lobes	pus evacuated No pus	Suprapulor tube out on fifth day Retention catheter out	Wound healed on twenty- fifth day	33	Cured
4	f I	Abscess of both lobes	Oz 11 of pus	Suprapuble tube out on second day Retention catheter out	Wound dry on twenty- fourth day Held one	32	Cured
109 10	78	Abscess involves both lobes	both Much pus	on seventeenth day Suprapube tube out on eighth day Retention catheter out on nucleenth day No re-	week for sounds Wound dry on twenty- eighth day	88	Cured
٧	α,	Abscess of hoth Johes	200	sidual urine on five examina- tions Supramilie tithe out on third	Wound dry on twenty-	88	Cured
•	3			day Retention catheter out	fourth day		
7	84	Abscess of both lobes Operation on eighth day after admission	Much pus and much muco-bloody discharge from bladder	Su	Wound dry on fortieth day	32	Cured
				Retention catheter in and was taken out on fortieth day No residual urine in two examinations Sounds passed easily			
	_						

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OPERATIONS FOR PERINEAL DRAINAGE OF PROSTATIC ABSCESSES

Condition on discharge	Fistula present Patient passing urne through perineal wound To return for third operation	Small amount of urine by perineal wound Home O K	Cured	Cured	Cured	Cured	Discharged O O R Home passing 80 per cent of urine by pen-	Home on fifteenth day. A O R No leakage through permeum, epididymitis, subsided	Cured, permeal wound healed	Home cured No leakage
Days in hospital	42	34	20	13	21	10	7	15	15	7
Results	Wound draining on twentieth day, second operation to days later Wound again discharges urne on forty-second day	85 per cent of unne pass- ing through pens on thirtieth day	No unne by permeal m- cision on fifteenth day	Discharged on thirteenth day Dry	No urme passed by perrneum on eighteenth day	No dramage from pen-	Leaking by perineal wound on seventh day	Acute double epididy- mins developed on seventh day, chills on seventh and eighth	No urne by permeum on fourteenth day Slight urethral discharge is present	Dry on seventh day
Special treatment	Tube out on fifth day Sounds 24 and on thurteenth day Sounds many tunes following	Tube out on second day	Tube out on second day 24–28 French sounds	Tube out on third day Sounds seventh and	Tube out on fourth day day, early	Fube out on fourth day	Tube out on second day	Tube out on first day after operation	Tube out on fourth day 25 F sounds on seventh and fourteenth days Ophthalam test before operation o per cent – 20 per cent After operation 4 per cent –	12 per cent Tube out on fourth day
Operative findings	Much pus Severe hemorrhage	Much pus	Doubtful	Pus found	Fewgtt of pus	Few gtt of pus	No pus	Much pus found	Large amount of pus	No pus
Pre-operative findings	Alcoholic abscess of right lobe In for 6 days before operation	Abscess of both lobes	Abscess involves the left lobe	Abscess of both lobes	Abscess of both lobes Operation on sixth day after admission	Abscess of both lobes	Abscess of both lobes	Abscess of both lobes	Abscess of both lobes Operation on tenth day after admission Abscess and ruptured through	Abscess of both lobes
Age	25	36	35	44	39	18	70	4	39	23
Case	H	0	в	4	10 404	9	7	8	6	10

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I am greatly indebted to Dr James R Pinkston for the investigation of the subject of prostatic abscesses on the Urological Service at Bellevue Hospital, during the year 1917 These statistics show conclusively the advantage of the perineal over the suprapubic method of drainage for prostatic abscesses

### CHRONIC PROSTATITIS

There is a wide difference of opinion regarding the frequency with which chronic inflammation of the prostate occurs. Lagneau as early as 1815 called attention to the fact that chronic prostatitis occurred frequently as a complication of gonorrhæa. Verdier in 1838 gave the first accurate description of the pathology of chronic prostatitis. Montagnon, Eroud, Pezzoli, Casper and Wallach found chronic prostatitis as a sequel of gonorrhæal urethritis in from 70 to 94 per cent of the cases. Hogge and Frank state that every case of posterior urethritis is complicated by prostatitis. Guyon and Furbringer, on the other hand, consider chronic prostatitis a rare condition.

A careful study of my own series of 350 post-mortem specimens shows that there is evidence of inflammation of the prostates in a large majority of the cases

Ethology —Young, Geraghty and Stevens found that chronic prostatits followed gonorrheal urethritis in 73 2 per cent of their cases, masturbation in 75 per cent, prolonged sexual excitement without coitus in four cases and withdrawal in 08 per cent, instrumentation 06 per cent, traumatism 08 per cent, infectious disease (influenza) 03 per cent, and no etiological factor determined in 148 per cent

Bierhoff found that 57 of his 62 cases of chronic prostatitis were due to the gonococcus, the remainder showing a mixed infection. On the other hand, more careful studies by Porosz and Cohn lead them to believe that the gonococcus is not so frequently present in chronic prostatitis. Wassidlo, Schromm, Jadassohn, Ruggles, and Goldberg believe that a mixed infection is the usual finding

My own observation is that following every case of posterior urethritis there is involvement of the prostate to a greater or less extent as manifested by persistence of comma-shaped casts of the prostatic duct orifices in the urine, nodulation and induration of the prostate and the occurrence of pus cells in more than the usual quantity in the prostatic fluid. The gonococcus is not usually found except very soon after the urethritis has subsided

Prostatic Fluid — The prostate gland is beyond question an organ essential to the virility of the male in all animals. The experimental work of Serralach et Pares has shown that there is an internal secretion which has a definite effect upon the other sexual organs. Removal of the prostate causes a cessation of activity in the testicles and seminal vesicles. Injection of a glycerin extract of the prostatic tissue prevented atrophy of the testicles and spermatozoa were given off in emissions in the normal manner.

Prostatic secretion is a milky fluid which has a penetrating odor and is alkaline or neutral to litmus and slightly acid to phenolsulphonephthalein

# PATHOLOGY OF THE HUMAN PROSTATE GLAND

Microscopically the prostatic fluid may consist of the following elements Lecithin bodies, pus cells, epithelial cells, compound granular cells, corpora amylacea, erythrocytes, and spermatozoa

The lecithin bodies vary in size from very small refractive points to bodies the size of a pus cell, and are most numerous in normal fluid, in fact, a comparison between the number of lecithin bodies to that of pus cells offers us a basis upon which to determine the degree of pathogenicity of the fluid being examined. It is my custom to estimate fluid upon a percentage basis. If the number of pus cells was so increased and the lecithin bodies decreased to the point where these two elements were about equal in number, one would say that the prostatic fluid shows 50 per cent pus. If there were three times as many pus cells as lecithin bodies one would estimate the amount of pus to be 75 per cent, etc

Epithelial cells are present usually but rarely to any great extent. Again referring to a percentage basis one usually finds that from 2 to 10 per cent of the structures found in prostatic fluid are epithelial in type. They are the cells cast off by the lining mucosa of the prostatic ducts and tubules. In situ they are columnar, but as soon as they are cast off they assume a rounded appearance and are flattened.

In nearly every specimen of prostatic fluid will be found a few very large cells, epithelial in type and containing large numbers of globules, which vary greatly in size. These cells were first noted by Waldeyer, who described them as compound granular cells. They occur most often in old men, and may comprise as much as 5 per cent of the structures, they are apparently degenerated epithelial cells.

Corpora amylacea are found most often in the prostatic fluid of old men, but may occur at any age after puberty. I have not observed them in specimens earlier than that

Erythrocytes may occur in large numbers in a prostate which is too severely traumatized by massage, they are usually present in prostatic fluid expressed from a gland which is the seat of an acute or subacute inflammation

Spermatozoa are frequently expressed with the prostatic fluid, due to pressure upon the ejaculatory ducts. These are usually very active when observed in the fresh specimen under the microscope because they are thoroughly mixed with prostatic fluid.

It is proper in treating a case of chronic prostatitis to make frequent microscopic examination of the fluid expressed by massage as it really indicates, more than does the palpating finger, the conditions present. Notthafft quite properly states that changes in the secretion are much more frequent than changes in the prostate, as noted by rectal touch, and he also points out that pus does not make its appearance in some instances until after the prostate has been massaged from two to five times

I have noticed that frequently after a long period of massage the induration may entirely disappear and the prostate feel quite normal, but the

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prostatic fluid will be loaded with pus This condition may persist for some time, then pus suddenly disappears from the prostatic fluid and delayed cure will rapidly materialize ultimately

It is our custom to stain the prostatic fluid at least once, usually at the first visit, in order to determine the presence or absence of bacteria

The importance of the prostate as a focus of infection can not be over estimated. In my opinion it is second only to the tonsils as a cause of arthritis, and may frequently be the cause of endocarditis and neuritis. A number of cases of arthritis have been referred to me recently by an orthopædic surgeon, who, after eliminating the tonsils, teeth, and sinuses of the skull, has suspected the prostate

I shall quote one case in detail as it is quite typical

J J, stage carpenter by occupation, aged thirty-four, married, gave a history of a long siege of gonorrhœa about four years ago was apparently cured, and three years ago married before consulting me he had been exposed to some inclement weather and had had a severe polyarthritis which had affected the small joints of the feet, the ankles, and the knees particularly He was confined to his bed for ten weeks and was able to hobble about with great difficulty Upon physical examination his urine showed Glass I, shreds, Glass II, clear, Glass III, comma-shaped shreds which were evidently casts of the prostatic duct orifices squeezed out in the last act of urination Chemical examination of the urine showed no abnormality examination of the prostate per rectum revealed a gland about one-half the usual size indurated moderately throughout with several nodules near the base of the gland on each side Many cord-like adhesions extended from each lateral surface to the surrounding pelvic structures, particularly at the base The seminal vesicles were barely palpable on each side

Prostatic fluid expressed by massage showed it to be loaded with pus, practically no lecithin being present. There were a few epithelial cells and an occasional compound granular cell

He was given a prostatic massage every other day for two weeks Following the massage he passed his urine and about I dram of 10 per cent argyrol was instilled into the urethra with a very soft rubber catheter. He was able to return to his work, the treatments being continued for a period of two months, with the result that his joints cleared up so that he walks with only a slight limp, and is able to attend to all his arduous duties

The signs and symptoms of chronic prostatitis are varied and in addition to the familiar pains in the back and morning drop one may meet with almost every degree of sexual disturbance always accompanied by neurasthenia. The pain is usually located in the small of the back, or may exist as a heaviness in the rectum. The latter type usually is accompanied by a history of the passage of prostatic fluid upon defecation. Pains may be referred down the backs or insides of the legs, or into the groins. It is

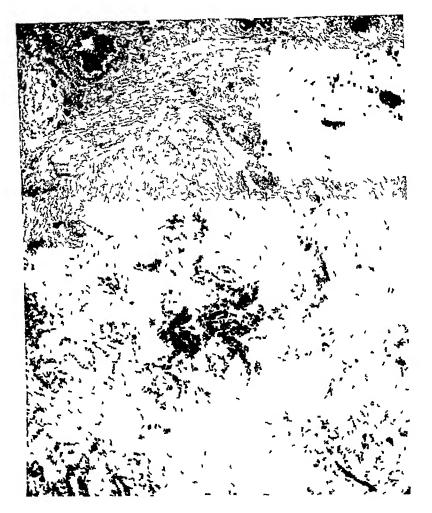


Fig I —Abscess of prostate

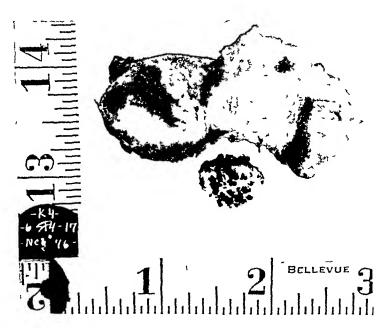


Fig. 2 —Enlargement of prostate and subcervical group, stone removed from bladder at time of operation



Fig 3 —Enlargement of prostate and subcervical group of tubules (Dr Barringer's case)



Fig. 4 —Other side of same specimen showing marks of vesical sphincter on subcervical group

# PATHOLOGY OF THE HUMAN PROSTATE GLAND

not infrequent to have prostatic pains simulate the pain that accompanies renal calculus

The urine practically always shows shreds, usually the comma-shaped ones which occur as casts of the prostatic duct orifice. Frequent and painful urination is usual and one may meet with hesitancy or precipitancy.

Rectal examinations will readily disclose the existing conditions. Chronic prostatitis is practically always accompanied by chronic seminal vesiculitis. The prostate is the seat of induration and nodulation and nearly always one may feel adhesions extending from the lateral border to the surrounding pelvic tissues and to the seminal vesicles, usually such prostates are enlarged and occasionally they may have boggy regions between the areas of induration. I never consider a case of prostatitis properly investigated unless a cystoscopic examination is performed, although I frequently postpone such examination until after the most distressing symptoms have been allayed by treatment.

Treatment—The treatment of chronic prostatitis consists for the most part of prostatic massage followed by a cleansing of the urethra either by irrigation with silver nitrate or potassium permanganate solutions or by the passage of urine followed by instillations of argyrol, silver nitrate or other antiseptic solutions into the prostatic urethra. Every two or three weeks, the urethra is dilated with sounds or preferably by the Kollman dilator

Thomas, of Philadelphia, in a recent publication has concluded that (1) Chronic prostatitis may be and is at times a surgical disease requiring prostatectomy for its efficient treatment (2) Chronic prostatitis is not infrequently associated with hyperplastic polypoid, papillary or nodular formations of the mucosa of the prostatic urethra and vesical orifice demanding removal by treatment coincident with that directed to the prostate (3) Fulguration or the high-frequency spark promises to offer the best method of intra-urethral treatment for this purpose (4) In the protracted cases of chronic prostatitis cysto-urethroscopy is always indicated and may be obligatory for proper diagnosis and treatment. Rarely will a case fail to respond to the palliative methods described above, provided the treatment is continued for sufficient length of time, hence, surgery of the chronically inflamed prostate should be a very rare outcome, although there are cases in which it would appear to be justifiable

Tuberculosis — Tuberculosis of the prostate does not occur with particular frequency. It is a disease of the young adult and usually occurs during the third or fourth decades. It is usually hæmatogenous in its origin, although it is not infrequent for it to accompany a tuberculosis of the epididymis and seminal vesiculitis in which case the lesions may be largely confined to that side of the prostate upon which the seminal vesiculitis exists, indicating that the disease may be borne by the lymphatics as well

Wilson and McGrath found only seven cases of tuberculosis out of 468 patients studied, and call attention to the fact that the periphery of the lateral

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lobes is the most frequent site of the disease, and not the neighborhood of the urethra

In my own series of tabulated cases, which now numbers more than 500, I have observed about 10 cases of tuberculosis of the gland Examination reveals a nodular elastic gland which is usually unilaterally affected and differs from the carcinomatous organ in that the latter is board-like in its consistency. The differential diagnosis may be extremely difficult, however, and I was allowed the privilege of examining a case with Dr. David W. MacKenzie, which I considered carcinomatous, and which upon removal proved to be tuberculosis of a low grade.

The tubercle bacilli become deposited in the walls of small capillaries, and tubercles develop. The bacilli are usually to be found in the borders of tubercles which extend in the usual manner.

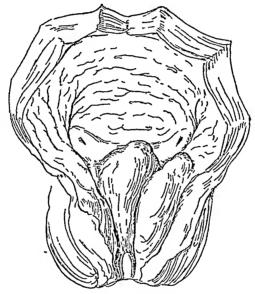


Fig 5 -

Operations upon tuberculous prostates are to be performed but rarely, as resulting sinuses are the rule Halle and Motz recommend that even in cases of acute secondary abscesses no operation should be done

Irving S Koll has reported a case of primary tuberculosis of the prostate in which the gland was removed with apparent cure. He found two other cases in the literature

Syphilis—Syphilis of the prostate is an exceedingly rare occurrence Although this dire disease seems to affect almost every other organ with more or less regularity, the prostate which harbors practically every other type of infection is graciously allowed to escape. I have not as yet come in contact with a single case of syphilis of the prostate gland.

Prostatism —As Keyes points out, prostatism may be either sclerotic or adenomatous in type A great deal has been written on this subject,

### PATHOLOGY OF THE HUMAN PROSTATE GLAND

and recently Simpson, of Buffalo, has advanced the theory that the condition is caused by the growth of multiple adenomata, that these changes are most marked at the oldest part of the new-growth, and therefore correspond to such growth centers as have been demonstrated

Simpson's discussion of literature is very complete

"Virchow taught that the so-called hypertrophy should be separated into two classes, one belonging to the myomata, and the other to the gland tumors, from which we must conclude that he considered the enlargement of the prostate as a true tumor formation

"Billroth wrote that in so far as his investigations went, prostatic hypertrophy was never connected with adenoma formation, but was a dilatation of the acini with perhaps some hyperplasia. He believed that nodular or diffuse myoma formation was common

"According to Social, prostatic hypertrophy is a name given to a variety of pathological conditions having in common the enlargement of this gland. In his opinion the ordinary enlargement is neither of inflammatory origin nor a true hypertrophy, but a true tumor formation

"Cohnheim stands out definitely for the tumor theory, as may be concluded from the following 'The new growth which one commonly calls hypertrophy of the prostate is neither inflammatory tissue nor, notwithstanding its name, legitimate hypertrophy, but true and undoubted tumor formation'

"Laundis, a pupil of Guyon, did not consider senile prostatic hypertrophy as true tumor formation, but as a part of an extensixe arteriosclerotic process which begins in the kidneys and extends throughout the entire genito-urinary system

"Rindfleisch assigned the cause of prostatic enlargement to tumor formation. He described two forms, the more rare fibrous, accompanied with atrophy of the glands, and the much more common form, namely, the discrete nodular adenomatous

"Birch-Hirschfeld considered the enlargement of this gland as an expression of new-growth, and assigns its origin to the budding of the gland tubules

"Lydston believed that prostatic hypertrophy began in the period of sexual activity and was the result in the majority of cases of sexual excesses

"Jores called attention to the fact that apparently hypertrophy of the so-called middle lobe took its origin in the suburethral accessory glands

"Aschoff demonstrated these suburethral accessory glands not only in males but also in females in the new-born

"Ciechanowski wrote a voluminous article supporting the inflammatory theory of prostatic enlargement, particularly emphasizing the part played by gonorrhœa. He believed that a long continued chronic inflammation was the basis of the changes which take place in prostatic hypertrophy. He admits that true adenomata and myomata may occur rarely, but they have nothing in common with prostatic hypertrophy.

"Beginning with Albarran, the majority of French investigators (Motz and Perearnau, Marion, Marquis, and Chevassu) hold that prostatic enlargement is due to true tumor formation, their only difference of opinion being in regard to whether they take their origin from periurethral accessory glands or whether they may spring from any part of the gland itself

"Stoker does not believe in the so-called middle lobe, but holds that the enlargements which occur at the proximal urethral orifice are caused by either myomata or adenomata. The enlargement of the gland proper he considers as a true hypertrophy, which may be associated with encapsulated adenomata.

"Rotschild advocated the inflammatory theory, and believed the enlargement was due to dilatation of the acini caused by obliteration of the excretory ducts. Bangs also upholds this view, although he believes that gonorrhea plays little or no part in the

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process, but would emphasize the factor of long continued congestion which occurs in long continued and often repeated sexual excitement

"Wichmann, in an investigation of the etiology of prostatic enlargement, concluded that inflammation plays little or no part in the production of this condition

"Wallace, Tietze, and Lendorf accept prostatic enlargement as adenoma formation, the latter holding that the tumors always spring from the periurethral accessory glands

"Alexis Thomson, in a series of ninety enlarged prostates, wrote that he had never met with an encapsulated adenoma or fibro-adenoma and doubts if such exists He believes the enlargement to be due to diffuse hyperplasia of both the gland and musculofibrous tissue

"v Frisch declares that we can only conjecture concerning the cause of these idiopathic tumor formations, the definite cause being unknown

"Adams and Nichols teach that while prostatic hypertrophy may precede the development of definite neoplastic conditions within the organ, it must nevertheless be sharply distinguished from the same 'With the more recent authorities we would regard it as the outcome of a long-continued, chronic inflammation, more particularly involving the urethral portion of the gland'

"Simmonds, in Aschoff's Pathological Anatomy, writes that the more recent thought concerning hypertrophy gives a very subordinate place to the inflammatory, and considers the enlargement of the organ to be due to true tumor formation"

Tandler and Zuckerkandl's very thorough study on the subject is an exceedingly valuable research and discloses many features of great interest. They contend that hypertrophy of the gland always begins in the middle lobe which enlarges and compresses all other portions of the organ. As a matter of fact, my own studies have shown that the most frequent portion of the gland to enlarge is really a contiguous structure, the subcervical group of tubules. Enlargements occur in more than 23 per cent of males over thirty years of age. This may occur without any enlargement of the prostate proper whatever. When the prostate itself enlarges there is usually a certain amount of enlargement of the subcervical group.

Adenomatous hypertrophy of the prostate occurs in both lateral lobes and the middle lobe most frequently—very rarely the anterior lobe may be affected. This has occurred four times in my experience. The posterior lobe is almost never the seat of this type of lesion. The portion of the gland which intrudes into the bladder is usually the subcervical group, which is recognized microscopically by the fact that there is very slight tendency of the mucosa to become heaped up and project into the lumina which are lined with many layers of cuboidal epithelium instead of the single layer of cylindrical epithelium which lines the prostatic tubules. Furthermore, there is not present the muscular envelope that is found in the prostatic tissue proper

Rarely there is an intrusion of the middle lobe proper, in which case the trigonum vesicæ is thinned out, and the vesical sphincter is lifted up and so thinned out as to become obliterated. Frequently the subcervical group may be found imbedded in the middle lobe. The lateral lobes may also intrude in a similar manner, but the intravesical intrusion is usually merely reflected through the wall of the bladder and does not actually occur

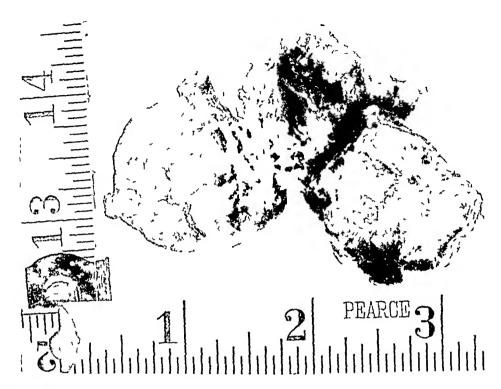


Fig. 6—Enlargement of anterior or ventral lobe of prostate as well as both lateral and middle lobes

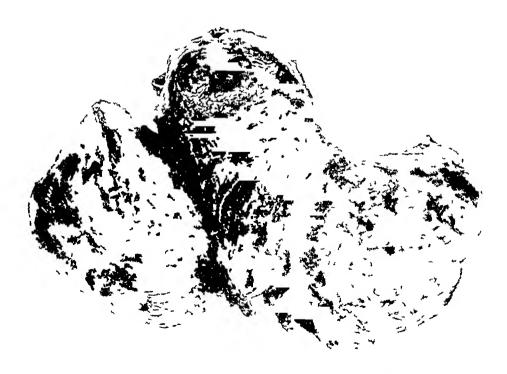


Fig. 7—True enlargement of middle lobe with the subscriptal group imbedded in it. We also increased between the two strictures obliterated



 $\Gamma_{IG}$  8 —True enlargement of middle lobe of prostate (Dr. Frederick W. Smith scase)



Fig. 9 —Section of prostate showing preponderance of interstitial tissue

Fig 10—Cystic type of hypertrophy of the prostate showing so called bridging

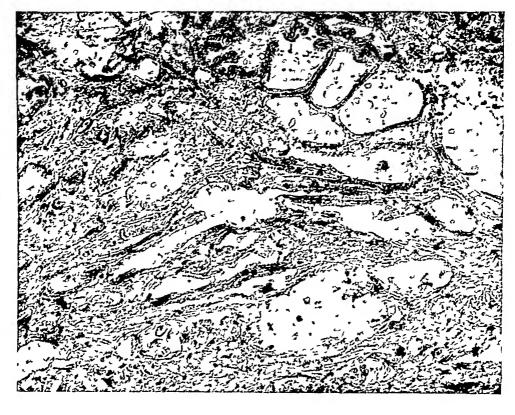




Fig is —Cystic type of hypertrophy of prostate, showing tendency of the cylindrical mucosa to degenerate. There are a few small corporating lacea present



Fig 12 —Cystic type of hypertrophy of prostate, tubule denuded of its mucosa

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Subsequent to the enucleation of a true middle lobe intravesical intrusion the finger inserted through the vesical orifice will feel the gripping of the tissue. This may occur even though the sphincter muscles themselves are entirely obliterated by the middle lobe and is due to the elasticity of the capsule of the prostate, which contracts very considerably upon removal of the gland, and gives a sphincteric effect. The vesical sphincter is more or less dilated and its efficiency destroyed after any suprapubic enucleation of the gland, and is not usually affected by a perineal operation, as shown beautifully by X-rays taken of a thorium filled bladder after each procedure

Non-malignant enlarged prostates present several types, considered from the microscopic standpoint (A) The most common type met with is characterized by a dilatation of the tubules which are lined with a single layer of tall cylindrical cells with the nuclei near their bases. Usually the lumina show an intrusion of the mucous membrane in the form of papillary projections due to the proliferation of the mucosa. Frequently the lumina are so extended and the interstitial tissue so limited between tubules that the epithelial cells are situated on membranes which are placed back to back without either muscular or connective tissue cells intervening to any great extent. This process is commonly called "bridging" and has hitherto been explained by the statement that the mucosa has grown across and joined to that of the other side of the lumen. The thinning out process, due to marked distention of the individual branches of the tubules, however, seems to me to be the true explanation of this interesting condition

(B) Further extension of this process results in the formation of cysts, usually small but sometimes so large as to occupy one-half of the enlarged prostate, as in a case recently operated upon at Bellevue Hospital by Dr Alfred T Osgood, in which most of the tumor disappeared upon opening into the lateral lobe of the organ, surrounding the groups of dilated tubules and their branches there is a layer of greater or less thickness, composed mostly of fibrous tissue, although in some instances there may be considerable smooth muscular tissue, shown by Van Giesen's method of staining

There may be an unusual amount of fibrous tissue laid down, in which case the structure becomes (C) fibroglandular in type

The latter may become very pronounced, in which case we have a large increase in the fibrous connective tissue or smooth muscle fibres or both, and have (D) the fibrous type with more or less compression of the tubular elements which do not then display the granular hyperplasia found in group A

Surrounding the acini in all of the above-mentioned types of prostatic hypertrophy are found evidences of chronic inflammation. There is a marked infiltration of small round cells near the basement membranes of the prostatic tubules. This increase in cellular elements varies greatly in individual cases and in some instances causes a marked induration due to their presence in excessive numbers. The presence of this inflammatory tissue explains the occasional relief from symptoms sometimes met with

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when a patient with an enlarged prostate refuses operation, and is given palliative treatment in the form of prostatic massage instead

Exfoliation and other changes of the mucosa occur very readily in the

prostate gland of the aged, and is noticeable in nearly every section of a removed prostate examined In old age the prostate either becomes the seat of hypertrophy or atrophy The gland practically never remains normal in size any more than it does in efficiency as compared with the normal gland of middle age

In my series of autopsy specimens, I found that in the old-age period there was a deviation of some sort from the normal in 56 per cent of the cases, 33 per cent of the prostates of all subjects over sixty years of age showed a certain definite degree of adenomatous hypertrophy Statistics gathered from the urological service at Bellevue Hospital, with the permission of Dr E L Keyes, Jr, present some very interesting facts with regard to results of operations upon cases showing enlargement of the prostate and will be discussed fully in another communication

Carcmoma -At the present time investigators are unable to decide whether malignant disease generally is on the increase or whether our ability to diagnose malignant conditions is improving. Both conditions may be correct. The same thing applies to a consideration of prostatic malignancy as to cancer elsewhere. This is reflected in statistics reported at various times

Fanchau found 5 carcinomata in 8289 prostates examined Von Winiwarter discovered one prostatic cancer among 548 cases of carcinoma warter discovered one prostatic cancer among 548 cases of carcinoma studied. Thompson (1854) published 18 cases which he had collected from the literature up to that time. Wyss (1866) added 10 cases, making 28 in all, Socin (1875) reported 50 cases, Kaupste (1885) 114 cases, Engelback (1888) 114 cases, Wolff (1899) 110 cases, Young 68 cases among 260 enlarged prostates. Belfield 10 per cent of all hypertrophies. Wilson and McGrath, who collected above statistics, reported (in 1911) 73 cases among 468, or 155 per cent carcinomata. Judd operated upon 93 cases, 21 in the sixth decade, 34 in the seventh, 36 in the eighth, and 2 in the ninth Wilson and McGrath, in their earlier series of 73 cases, found. One between 40 and 50 years, 12 per cent, in the eighth. and 41 per cent in the eighth

and 41 per cent in the eighth

Carcinoma occurs more frequently as a primary growth, but may occur as a secondary implantation. Geraghty has pointed out that primary carcinoma of the prostate begins in most instances, 49 out of 50 cases, in the posterior lobe. This part of the gland is the only part which consistently does not take part in adenomatous hypertrophy of the prostate gland. The extension of carcinoma occurring in the posterior lobe is upward to the base of the prostate, where it involves the seminal vesicles, and only after it has ascended above the upper edge of the intervesicular fascia, described fully by me in another article, does it attack the rectum, being protected in

### PATHOLOGY OF THE HUMAN PROSTATE GLAND

the region of the prostate itself by the fascia of Denonvilliers The lateral and middle lobes of the prostate are, of course, involved rather soon in the development of the condition Metastases occur quite early and are prone to attack the bones, more frequently than any other parts

As Young and Geraghty originally pointed out, carcinoma of the prostate presents ordinarily a hard, tense structure which on pressure gives very little sense of elasticity and has, as we are in the habit of saying, a board-like rigidity. When cut with a knife one gets the same sensation that is imparted when one cuts cartilage. Irregularly interlacing bands of varying size are seen, with small grayish-yellow isolated masses which are collections of cancer cells.

Carcinomata of the prostate most often met with are the medullary types, although colloidal and melanotic cases have been reported. Keyes correctly states that no amount of epithelial proliferation within the acinus is evidence of carcinoma of the prostate, for these changes may be brilliantly illustrated in simple prostatism. There is a wonderful variation in the appearance of the tissues in adenocarcinomata. Being outlaws, of course, the cancer cells may show all variations in size and appearance in a single field. The acini are frequently much distorted and a break through the basement membrane with interstitial infiltration is invariably demonstrable. Scirrhus carcinoma shows a marked infiltration into the stroma of outlaw cells which may be gathered in nests or may occur in extensive rows.

Sarcoma — Sarcoma of the prostate is a disease of the young and may occur so early and extensively as to lead us to the belief that it may have begun even before birth. Social discovered a case in a child of eight months which involved the entire pelvic cavity, having evidently begun between the bladder and rectum. Bree reports a case nine months of age. Thirty-one cases were reported by Powers of which three occurred in children less than one year, 12 of the remainder were under eight years of age, 8 between fifteen and twenty-four years of age, and 6 between fifty and seventy years. Gibson in 1909 reported 2 cases of his own and tabulated 35 other authenticated cases.

An enlarged prostate occurring in a child or youth must be considered suspicious of sarcoma. These tumors grow rapidly and may involve the bladder and rectum and practically fill the pelvis in later stages.

Metastases are common to neighboring lymph-glands, lungs, liver, and frequently bones. Sometimes the urinary symptoms are entirely absent, but pain is a constant symptom. Indeed, these cases usually have to be kept under the influence of opiates constantly in later stages.

Histologically these tumors show great variation. Lagneu describes them as globocellular, fusocellular or composed of polymorphous cells. Certain tumors are composed of a variety of tissues, myosarcomata, angiosarcomata, chondrosarcomata and rhabdomyomata. The commonest are the round-celled and the spindle-celled types.

Dr F J Parmenter, of Buffalo, has sent me a specimen of the spindle-

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shaped variety which he removed recently from a middle-aged man. Through the courtesy of Dr. Alfred T. Osgood, of Bellevue Hospital, I had the opportunity, some years ago, of following a case of spindle-celled sarcoma occurring in a young adult. At operation the prostatic tumor which had grown like wildfire was removed as a soft boggy mass. It promptly recurred and the patient died very soon thereafter

An interesting case came to autopsy at Bellevue Hospital recently, in which a sarcoma originating in the prostate had invaded most of the vital organs of the body

Prostatic Calculi—The presence of stones in the prostate gland is a very common thing, met with probably more frequently by the pathologist than by the surgeon, because ordinarily they do not cause symptoms. In my study of a series of over 250 prostates of all ages, obtained from routine autopsies at Bellevue Hospital, I found that true prostatic calculi occurred inbedded in the gland with great frequency. I did not keep accurate records, but I should judge about 20 per cent of the glands contained one or more calculi

Calculi are quite frequently met with in sectioning adenomatous prostates for microscopic studies and are generally supposed to be due to a deposit of calcareous material in corpora amylacea

One of my cases complained of difficulty in urination and apparently suffered no pain from the large number of calculi (325) which apparently filled every portion of the gland. One other case suffered from a prostatic abscess and the stones were removed in the course of the operation for that condition, which might have resulted from an acute infection accompanying the calculi

I am under the impression that prostatic calculi are as a rule quiescent and rarely give rise to symptoms, although occasionally a stone may pass after prostatic massage, and abscess arising from or accompanying the condition will give rise to pain in the perineum. Routine rectal examinations and X-ray exposures will reveal many more calculi of this organ than we have been in the habit of observing. The urinary and sexual symptoms are those which one usually finds in any chronic inflammatory condition of the gland

Most of the cases reported have shown the presence of a few calcula. Two of my cases are interesting in that one of them had 325 stones in the prostate and the other 126

Kretschmer has made studies of the composition of many calculi and states that "They consist in the main of phosphates, carbonates, or oxalates of lime, or magnesia or triple phosphates"

Lassaige (quoted by Glasel) gives the following composition of primary stones Calcium phosphate, 84 5 per cent, calcium carbonate, 5 per cent, organic material, 15 per cent

Dupuytren (quoted by Glasel) gives the composition of four stones obtained from a patient aged forty-one, as follows Calcium phosphate, 60 per cent, ammonium magnesium phosphate, 20 per cent, calcium car-

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bonate, 20 per cent The stones from Kretschmer's own cases consisted of calcium oxalate with a small amount of unidentified organic detritus in one case, calcium carbonate and calcium oxalate in another

It is important in interpreting rontgenograms of this region to remember that the large veins on the ventral and lateral surfaces of the prostate gland making up the plexus of Santorini are particularly prone to harbor phleboliths, as I have pointed out in a previous article

In removing prostatic calculi in young men not suffering from adenomatons hypertrophy the perineal exposure practiced by Young is the operation of choice. By painstaking effort the calculi may be removed through the lateral slits and most of the acini of the prostate left in situ. In one of my cases reported recently the prostate two years after the operation; is apparently free from recurrent or overlooked calculi and is performing its intended function in an entirely satisfactory manner.

Calculi coincident with adenomatous hypertrophy of the prostate are removed with the gland itself and those which are quiescent and discovered by accident should be left alone

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# THE HUMAN SEMINAL VESICLES AT BIRTH—WITH OBSERVATIONS ON THEIR FETAL DEVELOPMENT\*

# By Ernest M Watson, M D of Buffalo, N Y

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The basis for this report was obtained from the study in serial sections of the genito-urinally tract of a male fœtus at birth. The sections were cut 40 micra thick, stained in the usual manner in hæmatoxylin and eosin and every section from the urachus to the anterior urethra saved for study. In addition a reconstructed drawing was made from 120 serial sections magnified twenty-five times on millimetre paper to give a graphic representation of the outline of the seminal vesicles at this stage.

In this specimen of a normal human fœtus at birth the vesicles appear as well-developed paired sacculated organs, the lower borders of which are situated at the upper boundary of the prostate gland between the bladder and rectum. The left measures 4.75 by 3.75 mm in diameter, having its greatest length perpendicularly or anterior-posteriorly, and the right measures 4 mm by 4.7 mm and has its greatest diameter extending laterally from the ampulla of the vas. The upper boundary or tip of each vesicle reaches just below the lower limit of the trigone close to the lower boundary of the ligamentum interuretericum. At its uppermost extremity the lumen of each vesicle is less than one-half the diameter of the Wolffian duct or vas deferens in cross-section at the same level. This relation soon changes in the succeeding sections, however, until we have a several-cavitied vesicle each lumen of which is from three to five times the diameter of the vas

On macroscopic inspection each vesicle is a somewhat soft, lobulated body rather firmly enclosed in a fibrous tissue sheath which obscures much of the finer detail of interlobular structure and arrangement. In this specimen at birth the true peritoneum reaches just below the tip of each vesicle while the body proper of the vesicle is in close approximation with the rectum. This relationship persists until its lower third is reached where there is encountered that remnant of peritoneum, the so-called fascia of Denonvilliers, which is firmly attached to the vesicles and continues further down to cover the posterior or dorsal aspect of the prostate gland.

On cross-section the walls of the vesicles are made up of an inner lining of a single layer of somewhat cuboidal epithelium, beneath which is a definite basement membrane. This is supported by a few strands of thin fibrous tissue, the tunica propria, which is in direct contact with the muscular coat or wall. This muscle layer is nearly 5 mm in thickness,

<sup>\*</sup>Read before the Section on Genito-urinary Diseases of the American Medical Association, June, 1918

is everywhere circular in arrangement and of the smooth muscle type yond the muscle layer is encountered a fibrous covering, the tunica adventitia, which envelops the entire vesicle, with a few strands extending in between the separate cavities Each vesicle presents an extremely irregular outline, being composed of numerous outpushings of diverticula of varying depth and diameter. These for the most part are confined to the distal and middle The inner third, or that portion which joins the thirds of each organ Wolffian duct, termed the proximal canal, is pretty generally free from any appreciable number of diverticula The evaginations or outpushings arise not only from the main channel of the vesicle itself but in some instances from other evaginations On the whole, the picture is one of an almost tree-like growth with the branches of finger-like processes proceeding from the middle and distal thirds of each organ and growing for the most part in an upward direction Each branch or diverticulum ends as a blind pocket, but in every instance its lumen is patent throughout its main cavity and at its union with the proximal canal, the vesicle proper or with another and larger diverticulum

From this arrangement it is seen that the drainage is in the main downward and follows the natural path of gravitation. As the distal extremities of the diverticula certain angulations are met with in many instances which unquestionably lend themselves as ready sites for a stasis of their contents. and particularly is this true if at their point of origin from the larger diverticula or proximal canal there is a narrowing of their lumina from congestion, swelling and the usual results of inflammation. With this antomical picture it is seen that in order to obtain efficient drainage by surgical intervention multiple incisions are necessary and these for the most part should be made along the middle portion of the organ and particularly at the apex or tip of each vesicle where angulation with an anatomical tendency to pocket formation is great. In addition to the diverticula or finger-like processes mentioned above as arising from the proximal canal and vesicle proper, there are many smaller cup-like evaginations or depressions which have been These arise from the walls of the various pouches and also termed saccules from the vesicle itself and add greatly to the irregular and ragged contour of each organ yet present no added consideration from the standpoint of dramage because of their very shallow character Many of these saccules as well as numerous less well-defined depressions are supported by a definite framework of reticulations which gives the picture of an almost honeycombed structure when seen in cross-section This arrangement is more common along the distal or upper third of each vesicle

Careful study of the origin and course of the various finger-like evaginations arising from the vesicle have shown that in this specimen the vesicles are truly well balanced paired organs having ten definite diverticula or pouches entering into the formation of the vesicles on either side. This fact could be determined with certainty only on the reconstruction from successive serial sections of the form and outline of the vesicles under

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suitable magnification. In no instance in this specimen was the lumen on point of origin of any diverticulum found congenitally occluded or appreciably narrowed from the normal picture

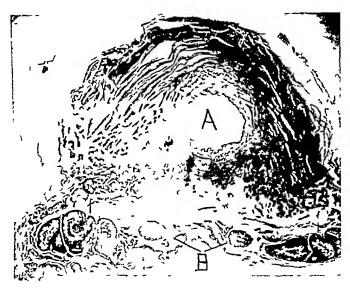
As has been described in detail elsewhere the first indication of the origin of the seminal vesicles occurs during the thirteenth week of fetal life as lateral out-pocketings of the walls of the Wolffian ducts just above the first observed tubules of the prostate gland. This evagination of the walls of each duct carries with it the mucous lining and basement membrane and is surrounded by a mass of undifferentiated mesenchymatous cells in all respects similar to the Wolffian duct itself. Definite furrows of constriction are encountered even at this early stage marking the union of the vesicle and Wolffian duct. This constriction gives the vesicle an almost pedunculated appearance. At its first appearance the vesicle measures 1/68 by 1/200 mm, having its greatest diameter extending laterally from the Wolffian duct

By the fourteenth week the organs have grown very appreciably in size and have become V-shaped or bifurcated at their distal extremities. Their growth for the most part has been lateralward from the Wolffian ducts. The branching of the tip of each vesicle is the first indication of diverticula formation, which phenomenon, however, is noted at other sites along the vesicle proper by the beginning irregularity of its walls and to a lesser extent along the inner third of the organ which portion has been termed the proximal canal. The histology of the vesicles has not changed perceptibly during this growth except to show a more close approximation of mesenchymatous cells about the basement membrane, which grouping shows a little deeper staining reaction. The vesicles now measure 1 by 5 mm in diameter.

At the sixteenth week the vesicles have increased very definitely in size over the preceding picture, but their general configuration remains the same. The growth has been for the most part in a perpendicular direction along the path of the Wolffian ducts. The distal extremities are still forked and along the body of the vesicle proper there is a still greater tendency to irregularity but no definite additional diverticula have appeared. The vesicles here join the Wolffian ducts at an angle of 45 degrees, while in the earlier specimens they appeared as direct lateral outgrowths at an angle of 90 degrees. They measure at this time I by 75 mm in diameter.

By the nineteenth week there has been a notable increase in the number and size of their diverticula. At this time can be counted seven well-defined finger-like processes entering into the formation of the left vesicle and five similar diverticula branching from the right vesicle. These in general are confined to the distal thirds of each organ. The proximal canal still remains as a definite entity but shows a moderate increase in irregularity. At this time is noted a dilatation of the Wolffian ducts with some slight irregularities

<sup>&</sup>lt;sup>1</sup>Watson "The Development of the Seminal Visicles in Man" Amer Jour of Anatomy, 1918 "The Developmental Stages of the Human Seminal Vesicles" The Jour of Urology, vol 11, No 2, p 129, April, 1918





 $\Gamma_{1G}$  2—Cross section through the left seminal vesicle and left vas deferens. Feetus at birth A, Five cavities of the vesicle showing at one level, B, left vas deferens.



Fig. 3 —Cross section through the distal portion of a single cavity of the vesicle showing the saccules and reticulated framework. Feetus at birth A Saccules B reticulated framework

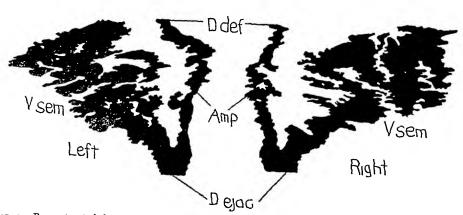


Fig 4 —Reconstructed drawing from 120 serial sections showing the seminal vesicles and Wolffian ducts
Fœtus at birth

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indicating the onset of changes incident to the formation of the ampulla of the vas

At the twenty-first week the striking picture is the overlapping and fusing of the elongated finger-like processes described in the previous stage. By this fusing is not meant a joining of the individual lumina but rather an alignment of two or more diverticula within the same outer fibrous sheath. This has taken place with only a moderate increase in the size of the vesicle, which arrangement gives an impression of wider and larger outpocketings which in reality are only superimposed diverticula. At this time nine well-developed branches go to make up the body of the left vesicle, while seven similar outgrowths enter into the formation of the right vesicle.

The development at the twenty-fifth week shows a still greater degree of overlapping and fusing of diverticula within a single fibrous sheath. This has taken place with no marked additional change in their gross architecture. The vesicular walls are now well formed and are composed of a definite musculature. In addition the region of the ampullæ shows considerable irregularity and dilatation. Each vesicle in the specimen studied at this stage is composed of five well-formed branches which make the vesicles well-balanced paired organs.

The interval between the twenty-fifth and thirty-first week of intrauterine life is the period of greatest growth, and at the latter time may be
counted ten well-developed elongated evaginations entering into the formation of each vesicle. These diverticula are very irregular in outline and in
lateral view give the effect of a very complexly branched tree. The locations
of the elongated processes of growth occupy a position as indicated in the
earlier specimens, namely along the middle and distal thirds of each vesicle,
and in the main grow in an upward or perpendicular direction. This gives
each vesicle an alignment almost parallel to the axis of the accompanying
Wolffian duct on either side. At this time the ampullæ are well dilated
and from each arise several sacculated finger-like processes in all respects
of a kindred form and structure to those arising from each vesicle proper

Between the thirty-first week and birth there occurs no appreciable increase in the size of the vesicles but the growth is rather an increase in the complexities and ramifications already present. It is during this interval, however, that the inner reticulated framework supporting the middle and distal portions of the vesicular walls is noted and in addition the smaller saccules make their appearance.

# TRANSVERSE ECTOPY OF THE TESTIS WITH MASCULINE UTERUS

### By T. KIMURA, M D

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Congenital displacement of the testis is not rare, but most of the cases are that of imperfect descent, namely, abdominal and inguinal. The transverse ectopy, however, of the testis, which Lenhossek first reported in 1886, is very rare. Since his report, according to my collective investigation, ten like cases have been found. Before describing a case that was under our observation, I desire briefly to summarize those collected from the literature

#### CASES REPORTED IN THE LITERATURE

Case I (Reported by Michael V Lenhossek in 1886)—The patient was a man aged thirty-five years, whose testicles lay on the left side of the scrotum and were of equal size. The two vasa deferentia were connected with connective tissue and passed together through the left inguinal canal, where they turned and reached the upper edge of the prostate, when they first divided—the left going directly to the normal left seminal vesicle, the right making a rectangular curve before uniting with the right seminal vesicle.

Case II (Reported by Max Jordan, 1895)—A boy eight years of age, with both testicles in the left side of the scrotum, each of them having its own tunica vaginalis. The vasa deferentia soon connected and for the most part formed one canal. The patient had left inguinal hernia and hypospadias

CASE III (Reported by Paul Linser, 1901)—A boy two and a half years of age with both testicles imbedded in the posterior cystic wall of the right scrotum. They were equal in size, appeared normal and were enveloped with the same tunica vaginalis. Both vasa deferentia were independent and not united to the bladder. The patient had a right scrotal hernia.

Case IV (Reported by A A Berg, 1904)—A boy aged thirteen years, with a large scrotal hernia on the left side from birth. Both testicles and cords were intimately connected with the hernial sac on the left side. The testicles were of unequal size but appeared normal. Both cords passed through the left inguinal canal. The cord of the smaller testicle passed through the left inguinal ring, crossed the space of Retzius, to the right inguinal region, thence it descended to the pelvis. The cord of the larger testicle descended on the left side of the bladder to the pelvis.

Case V (Reported by A L Halstead, 1905)—A man, aged thirty years, who was operated on for a left congenital irreducible inguinal hernia, had both testicles on the left side of the scrotum. The cord contained two vasa deferentia, two spermatic arteries, and two sets of veins, enclosed in one vaginal process. This double cord passed through the left inguinal canal. The right side of the scrotum and the right inguinal ring were empty.

Case VI (Reported by R Romanovsky and J V Winiwarter, 1905)—A male, sixty-one years of age, with both testicles in the left half of the scrotum, enclosed in one tunica vaginalis propria. The left testicle was greatly malformed and lay at the bottom of the sac. The misplaced right testis was situated above it and was slightly

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less malformed than the left The left spermatic cord passed normally, but the right crossed the median line and descended to the right seminal vesicle along the back wall of the bladder

CASE VII (Reported by Cornil and Bossard, 1907) —A boy nineteen years of age, in whom the external genitals were normal, was found at operation to have a tumor in the tunica vaginalis, which was extirpated There was a hypertrophic uterus 9 cm long, with two fallopian tubes A testicle was suspended at the end of one tube, and another at the uterine cornu of the opposite side

CASE VIII (Reported by D Castelli, 1909)—A man twenty-three years of age, in whom, at operation, two testicles were found on the right side of the scrotum; the left half was empty

CASE IX (Reported by A Duse, 1910) —A man, aged twenty years, with a diagnosis of inguinal hernia, was operated on, and both testicles and a masculine uterus with a single fallopian tube were found in the right half of the scrotum

Case X (Reported by H Iwasaki, 1912)—A man, twenty-four years of age There were two testicles on the right side of the scrotum and the left half was empty Between the two testicles was found a soft lump the size of a testis, connected with both testicles by fibrous membrane. The right spermatic cord passed up through the right inguinal canal, and the cord which belonged to the misplaced left testis came out on the inner side of, and underneath, the right outer hernial ring, passed down through the soft lump and was covered with the tissue of the vaginal process. The patient had suffered from right inguinal hernia.

# CASE OBSERVED IN THE HOSPITAL OF THE PREFECTURAL MEDICAL COLLEGE AT KYOTO, JAPAN

CASE XI -K T, a male student, aged twenty years, was admitted to the hospital October 7, 1914 Five months after birth, a swelling was noticed on the left side of the scrotum The doctor who was consulted diagnosed hernia and applied a truss, which appeared to cure the hernia When the patient was five years of age, the left half of the scrotum swelled suddenly during play and was reduced by taxis September 5, 1914, he noticed swelling, not painful, of the left side of the scrotum October 1, the swelling developed rapidly, the skin became red, and the patient suffered with pain and had no appetite This condition was followed by nausea and vomiting The physical examination revealed a medium-sized and well-nourished youth The elasticity of the skin was normal The face was anxious and its color was pale The tongue was slightly coated The temperature was 39° C, and the pulse was about 80 and of normal tension The lungs and the heart The abdomen was slightly distended, but there were no abnormal peristaltic movements The liver and kidneys were not palpable Extending from the left inguinal region to the scrotum of the same side, there was general swelling, and the left half of the scrotum was as large as the fist of an adult The skin over it was red and smooth Anteriorly and below, fluctuation was elicited, on percussion, there was dullness and with illumination it was translucent. At the upper part of the left side of the scrotum there was a mass tender to the touch and extending upward to the inguinal canal as a cord twice the size of the thumb Neither testicle could be touched from the outside A diagnosis was made of incarcerated hernia

Operation (October 7, 1914) —Performed under general ether anæsthesia. An oblique incision about 15 cm long was made through the skin

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along the left inguinal canal On opening the subcutaneous adipose tissue and fascia, a brown-colored tissue, resembling a hernial sac, was discovered When this was dissected out, about 30 cm of serous fluid of the same color flowed out and showed the omentum adherent to the sac The intestines were not found Because it was discovered that the sac communicated with the peritoneal cavity, an opening was made through the inguinal canal and a part of the peritoneum. There was a small amount of translucent and pale yellow fluid in the peritoneal cavity No special change of the intestines was discerned Just beneath the adherent omentum was a thick, firm cord which extended downward to the distended scrotum, upward deep in the pelvic cavity, and behind and underneath the bladder There was no connection of the cord with the intestines About 150 cm of yellow, translucent and somewhat gluey fluid flowed out when at attempt was made to dislocate the testicle This cord, the spermatic cord and the omentum had grown intimately together, with adhesions so dense that attempts at isolation were abandoned Near the internal inguinal ring the three tissues were amputated and, with the contents of the left side of the scrotum, extirpated The amputation stump was carefully sutured, because the stump of the cord had a lumen and its inner surface was covered with a tissue like the mucous membrane After the peritoneum was closed, the wound was partially closed and a small drain inserted

The day after the operation, vomiting ceased During the five days after operation, the temperature was 38° C to 39° C daily, after that time, the fever disappeared gradually and appetite improved. November 25, the patient left the hospital. The wound was healed, except for an area 25 cm in diameter. The scrotum on the affected side was empty. On the right side, a fine fibrous band came down from the inguinal canal, its lower portion was slightly thickened and attached to the bottom of the scrotum. Pressure upon it gave no testicular sensation. Nothing in the band could be found which resembled the seminal cord. Rectal examination with the finger through the anal canal revealed no special abnormalities.

Pathologic examination (gross specimen) showed a thick-walled cyst, two spermatic cords and a cylindrical mass of tissue with a canal which was lined with mucous membrane. When the cyst was opened, two testicles were found, one of which occupied the upper part of the sac, the other lying in the bottom of it. Both testicles were of normal size and appearance and were situated in the horizontal plane with their major axis. Between them was neither septum nor membrane. Each testis had its own epididymis and normal sized spermatic duct. These ducts were accompanied by the spermatic arteries and veins and formed spermatic cords which were held together 3 cm. apart by connective tissue. The canal, the wall of which was 0.5 cm. thick and its lower end terminating in excal form, was between the cords.

Microscopic specimens were made of both testicles and of a transverse section of the canal, including spermatic cords. The examination showed two spermatic ducts, accompanied by their own spermatic arteries and veins. The inner surface of the ducts was lined with a cylindrical epithelium. No pathologic change was noted in the duct wall. The blood-vessels were generally congested, in some of them the lumen was only dilated, in others the middle coat was more or less thickened. There was no perceptible thickening of the tunica intima or narrowing of the lumen.

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The inner surface of the sac which terminated in cæcal form was lined by one or two layers of cylindrical epithelium with cilia. Just beneath these epitheliums was a stratum of fine fibrous tissue, in which were contained many connective-tissue cells, a small quantity of homogeneous intermediate tissue, and many leucocytes In addition many fine, dilated, congested blood-vessels and glands, lined with one layer of cylindrical epithelium, were found. These vessels and glands were irregularly arranged The tunica propria was connected directly to the muscularis mucosa was absent The muscularis consisted of smooth muscular fibre, the course of which was somewhat irregular, so that sharp limitation of the individual layer, such as in the bowels, was impossible in general, three layers could be differentiated an inner layer of longitudinal fibres adjoining the tunica propria, a middle circular fibre layer, and an outer longitudinal layer. The muscularis adjoined the fibrous tissue of the spermatic cord Here and there was a small amount of inflammatory cell infiltration. In short, the structural appearance, microscopically, resembled that of a uterine wall, not that of an intestine or a Meckel's diverticulum Microscopic sections of the testicles showed that the free surface of the tunica albuginea was covered with one layer of payement epithelium, as usual, and that both testicles were normally developed

Discussion — Considerable difference of opinion exists as to how the transverse ectopy of the testis is brought about Lenhossék explained the condition as follows "The abnormality may depend either on a faulty development of both testicles in one side, or on a faulty descent of the testis, due to the abnormality of the gubernaculum testis" He said that for his case, in which both spermatic cords ran close together, the first hypothesis is plausible. Jordan joined in Lenhossék's explanation and states the view that his case was caused by the union of both Wolffian ducts on their distal Linser remarked that it was inconceivable that a testicle which was originally in a normal position should pursue such an abnormal course in He expressed the same view as Lenhossék-that it was the faulty, one-sided origin of both testicles—because in his case both testicles were equally developed and held in a common tunica vaginalis. On the contrary, in the case of Romanovsky and Winiwarter, the spermatic duct of the displaced testis had its origin from the right side and, for the most part, followed the right half of the body, and the gubernaculum Hunters which belonged to the right testis passed through the right inguinal canal these facts, the authors inferred that the right testis must have been either pressed to the left side or taken with the left testis into the open processus vaginalis because of some abnormal connection. At the moment of the commencement of this deformity they state that the right testis must have passed through the inguinal canal before the physiologic closing of the left processus vaginalis

Under such circumstances, we know that there are two different points of view respecting the mode of origin of the transverse ectopy of the testis. I believe the cause of this disagreement to lie in the fact that each author's explanation was based on his own simple case, the anatomic conditions being

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different in every case, because the deformity is very rare. When both spermatic ducts pass through one side of the body absolutely, as in the case of Lenhossek and Linser, it may be recognized as a faulty development of both testicles on one side. There are some cases of similar transposition of other symmetric organs, as, for instance, the kidney. Stocquart reported a case in which a double kidney with two ureters was found on one side of the body, and none on the other. On the contrary, if one spermatic duct, after passing through the same internal ring with the other, crossed the median line and descended to the seminal vesicle on the other side, while the other duct took a normal course, it shows that a testicle has been displaced during its descent to the other side

It is much to be regretted that in our case the inside of the pelvic cavity could not be examined deeply, because the patient was feverish under the symptoms of incarcerated hernia, and at the time of the operation a browncolored serous fluid in the hernial sac and a canal of tissue lined with mucous membrane were found Therefore, an unquestionable decision in regard to the case cannot be given Each testicle was covered with its own tunica propria, and from each of them a normal-sized cord with its spermatic artery and veins passed upward From this fact it is inferred that the rudiment of a testicle was originally on each side, but at the beginning of the fetal period, there occurred an error of development in a part of the Wolffian duct, owing to a loose adhesion between the testes, and thus both testicles descended on the left side of the scrotum. There is no doubt that a tissue which has a structure resembling the wall of the uterus is a masculine uterus developed from persistent Mueller's ducts Doctor Tsunoda, of the pathologic department of our college, who inspected the specimen, was of the same opinion Cornil and Brossard observed, in a man, a uterus with two fallopian tubes and two testicles Duse noted a uterus unicornis with a single fallopian tube which was between the two testicles The reason for the existence of such a masculine uterus may be explained as follows originally, Wolffian ducts and Mueller's ducts run parallel to each other In the male the former develops continuously, while the latter diminishes by degrees after the tenth embryonal week But, if from some cause a part of Mueller's ducts remains behind and develops further, then there may occur a so-called masculine uterus

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### GIANT-CELL GROWTH OF BONE AND TENDON SHEATH

GIANT-CELL SARCOMA, BENIGN MYELOMA, ETC

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(From the Stanford University Laboratory of Surgical Pathology)

GIANT-CELL growths in bone and also in tendon sheaths are fairly frequent. In a rather thorough search I have not found a case in which bone and tendon sheaths were involved in the same patient. Following is the history

Mrs D, aged twenty-seven, March 15, 1916 The patient has been married eight years, and has one child eight weeks old She has had no miscarriages and has always been healthy. She sprained her right ankle three years ago, and the injury was followed by complete recovery. One year ago she sprained the ankle again. It has been painful ever since, and somewhat swollen, although it did not grow much worse. Four months ago it was sprained again. Since the birth of the baby the patient has been much worse. She has been on her feet more. She is nursing the baby and is feeling well, but thinks she has lost weight during the past week. She gives no history of sore throat, and her husband denies lues.

Examination—The patient limps She has a rounded, obscurely elastic swelling of the lower end of the right fibula, somewhat sensitive to firm pressure, but not accompanied by any inflammation A small, rather firm swelling is present below the lateral malleolus, not connected with the main tumor. The veins are dilated over the swelling

The X-ray picture shows a marked enlargement of the bone, with thinning of the cortex

Operation (March 17) —Esmarch bandage The incision was a longitudinal lateral one over the lower end of the fibula, laying bare the very thin shell of bone This thin shell was opened, and some of the contents were scooped out They correspond to the description ordinarily given of giant-cell tumors, except that they were more reddish brown than red

Professor Ophuls made a frozen section of the material, and pronounced the growth a giant-cell sarcoma. The incision was then prolonged distalwards, over the small mass below the malleolus. This mass, about the size of a bean, firm and rather elastic, was dissected from the peroneal tendon sheath, and the sheath was opened in the operation.

The cavity in the fibula was then scooped out thoroughly, and the thin lateral shell of bone was removed. Two more fairly large masses were discovered, and were dissected from the peroneal muscle and tendon sheath immediately behind the bone tumor but apparently not connected with it or with the other growth dissected from the tendon sheath. The cavity in the bone was swabbed out with alcohol and

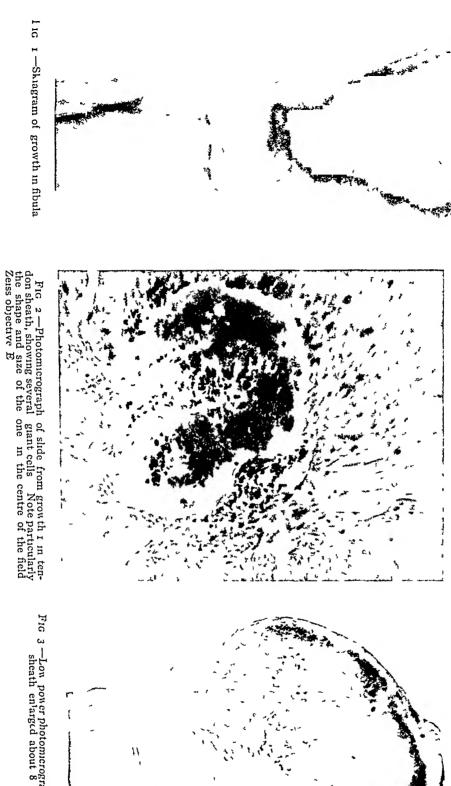


Fig. 3—Low power photomicrograph of small prowth 2 in tendon sheath enlarged about 8 diameters. Note capsule

l 1G 1 -Skiagram of growth in fibula

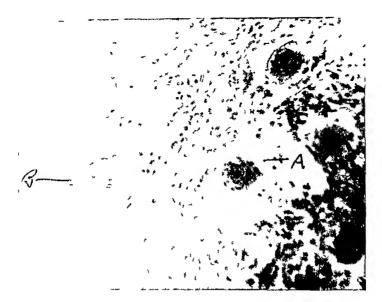


Fig. 4—Photomicrograph of slide from growth 3 in tendon sheath and the dense mass of deeply staining nuclei on B

Observe the process on giant cell A Zeiss objective E

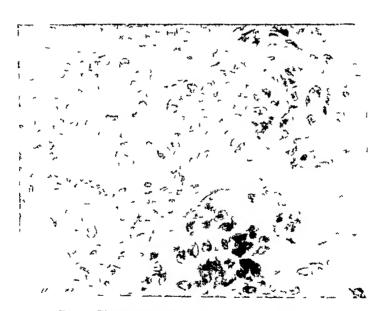


Fig 5 -Photomicrograph of growth in bone High power

carbolic acid, the wound was sutured in two layers, and the foot was put up in plaster of Paris The layer of bone on the medial aspect of the fibula was not disturbed, hence the mortise of the ankle-joint remained as before

The contents of the tendon tumors were similar to the contents of the bone, except that they were yellowish brown in color The largest one of the three was the proximal one

Histology—I Growth in tendon, below the lateral malleolus A well-defined capsule is present, except on one side Running in from one section of the capsule is a small wedge of osteoid trabeculæ with its base at the capsule In several places the growth is making its way through the capsule

The growth itself consists of a delicate stroma of fibrous tissue with an abundance of spindle cells (fibroblasts) and many giant cells. The giant cells vary greatly in shape and in number of nuclei. Some of the nuclei stain fairly sharply, and have a smooth outline and a well defined nucleolus. Some stain poorly, and have a dentated outline. Many are dead, and appear as granular collections. Scattered through the growth are many endothelial leucocytes.

The giant cells are irregular in outline, without a limiting membrane, and are composed of hyaline or faintly granular material. They look as if they had arisen from the fusion of a number of endothelial leucocytes, with a subsequent degeneration of the cell body.

A few blood-vessels are present and many larger or smaller clefts containing blood pigment /

- 2 The small growth in the tendon sheath, posterior to the growth in the bone, differs from it in having a capsule more nearly complete. It contains also a few trabeculæ of osteoid tissue. Here and there one can see a large, clearly defined cell containing many small, round, deeply staining nuclei. It stands out in sharp contrast to the other giant cells. Its cytoplasm also stains more deeply.
- 3 The large growth situated just distal to No 2 is similar to it It also contains a few minute trabeculæ of osteoid tissue, and in places shows hemorrhage into the tissue of the growth itself
- 4 Material removed from the bone tumor shows a delicate stroma of fibrous tissue, with masses of spindle cells and many giant cells similar to those described in the tendon growths, but not so large. A few thin-walled blood-vessels are present in the fibrous stroma, but the clefts described in No 1 are not present. On the other hand, hemorrhage has been free into the mass. A few small osteoid trabeculæ are present, but no normal marrow tissue.

Note—A letter from the patient on August 14, 1918, 29 months after the operation, says that she is in health, does her own housework, and suffers no pain or disability. There are no signs of the return of the growth

The nature of these giant-cell growths has occasioned considerable discussion, and has not yet been definitely settled. Until comparatively recently, when found in bone, they were regarded as malignant, and were treated by amputation. Even as late as 1913, Stewart still maintained their malignancy. Barrie considers that they are due to hemorrhage in the marrow, and calls the disease hemorrhagic osteomyelitis. Adami, Mathews and others view them as myelomata. They occur preferably in young adults of from

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twenty to forty years, and usually in the ends of the long bones or more rarely in the small bones In other words, they are located preferably where lymphoid marrow is present. They show no tendency to involve

Almost all recent writers (with the exception of J C Stewart) say that when they are thoroughly removed, they do not recur, or, if they recur, that they may be removed again without any fear of metastasis Bloodgood insists upon the importance of swabbing out the cavity in the bone with carbolic acid, but as to the actual necessity of this there is doubt, for no bacterial growth ever has been demonstrated in them They replace practically all the bone and normal marrow tissue at the site of growth cortex over them becomes thin and expands, and, when of great thinness, crackles on pressure—"egg shell crackling" The growth does not often perforate the cortex and involve the surrounding tissues

A history of trauma is often obtained, but whether the trauma is the cause of the disease or an effect, has not been determined

The contents of the giant-cell tumor in bone are usually characteristic friable, and yet with more or less cohesiveness, "currant jelly" in color, often with mottled areas of fibrous tissue They can be scooped out easily

No tendency to spontaneous cure has been noted, nor any tendency to secondary infection unless produced by unwise operative measures

Giant-cell growths of tendon sheaths have also occasioned considerable Fleissig thinks they are granulomata. Others call them sardiscussion comata Generally they run more to a yellowish color than to red

Histologically, giant-cell growths consist of a delicate stroma of connective tissue, with spindle cells and giant cells Some writers, e g, Mallory, view these last as foreign-body giant cells, others (Adami, Mathews) as true myeloplaxes In this case of mine they looked entirely unlike the typical myeloplax, but distinctly like the giant cell of a granuloma In fact, many of them have no likeness to a cell, and are only called giant cells from custom They would be described more properly as a collection of nuclei surrounded by an irregular mass of hyaline or faintly granular material The appearance of the growth in this case is distinctly that of a granuloma

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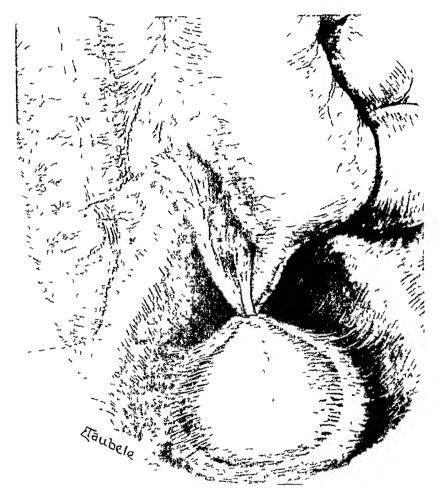


Fig. 1—Intestinal obstruction produced by evagination of ileum into urinary bladder through a perforated vesical ulcer—Ileum partially withdrawn to disclose ulcer margin

# INTESTINAL OBSTRUCTION PRODUCED BY THE EVAGINATION OF ILEUM INTO THE URINARY BLADDER

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Strangulation of the terminal ileum caused by its passage into the urinary bladder is possibly unique. Adhesions and embryonal remains may give rise to obstruction of both the lumen and blood supply of the hollow viscera. Of the adhesions, those arising from previous operation, an inflamed appendix or tube are common. Among the embryonal remains are abnormal cords and membranes, intra-abdominal peritoneal pouches, and congenital herniæ. The end-ileum is occasionally intussuscepted. But the following case presents strangulation that depends neither upon scar tissue nor hernial openings and, although it grossly resembles intussusception, is far different from it

S M, nineteen years of age, first seen April 30, 1918 His symptoms were nausea and vomiting, no movement of the bowels in six days, sharp hypogastric pain, abdominal distention, tenderness and rigidity in right lower abdomen His operative findings (same day) were acute dilation of the stomach and small intestine down to the distal ten inches of ileum, adjacent six inches of ileum tightly held within the urinary bladder, terminal four inches of ileum and whole of colon completely relaxed (the bladder was partially intussuscepted together with the intestinal loop so that it was at first impossible to be assured that the pathology was not a true enterovesical intussusception), punched-out ulcer, I 5 cm in diameter, in fundus of urinary bladder. There was a small amount of yellowish fluid, more resembling serum than urine, within the bladder and free in the peritoneal cavity. The bladder appeared normal without, and, barring congestion of the mucous lining, looked normal within The technic was freeing of obstructed loop, closure and inversion of ulcer, closure of right rectus incision in layers Findings at ileostomy performed after an interval of eighteen days confirmed the same dilated condition of the stomach and oral intestine above noted and described in accompanying drawing struction disappeared Notwithstanding the fact that the stoma was located well down in the distal half of the small gut, manition progressed and terminated fatally on the thirtieth day

Note—(1) Acute perforated ulcer of urmary bladder (2) Strangulation of small bowel by evagination within the bladder (3) Acute suppression of urme (4) Acute dilation of stomach and oral small gut (5) Inadequacy of the freeing of the obstructed loop and necessity of ileostomy

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bacteria are virulent they are growing fast. In this case it is impossible to close with any kind of bacteria. If the bacteria are not virulent it is possible to close, providing they are not streptococci or Welch bacilli

In a second period if a wound is not closed after the first period of equilibrium between the organism and the bacteria the bacteria adapted in the wound can grow, the equilibrium being destroyed in their favor. This is the period of acute inflammation during which, progressively, the organism is increasing its means of spontaneous defense. In the third period these means of defense are stronger than the attacking power of the bacteria, the development of the bacteria is arrested, and their virulence diminishes progressively.

During the second period, or period of acute inflammation, it is impossible to suture a wound, but during the third period, or period of diminution of the virulence of the bacteria, Levaditi says that it is possible to close a wound even if the bacteria are numerous, provided they are not streptococci or gas bacilli

To sum up the conclusions of Levaditi There are three periods in the evolution of the bacteria in a wound

- I In the first period we must resort to secondary suture early (within twenty-four or forty-eight hours after the injury) in the case of a wound which has been widely opened and treated by the Carrel-Dakin method, and which is known during the first hours to be sterile or but slightly infected by other bacteria than streptococci or gas bacilli
- 2 In the second period we must apply the Carrel-Dakin treatment and await la crise
- 3 In the third period "it is necessary to wait until the bacteriological chart reaches the zero point to close the wound, provided that these bacteria were attenuated and not streptococci"

But to apply these rules it is necessary to employ a bacteriological examination more complete than we did

Levaditi says that the cultures are the best index of the quality and the virulence of the bacteria, employing at the same time smears to measure the quantity of germs

The delayed secondary suture makes slower progress, because it is more difficult to be certain of the bacteriological condition of the wound in the granulating tissue. In this condition technic is still hesitating and the failures numerous. These failures are due to the granulating tissues which grow during the suppuration. Every granulating wound treated aseptically cicatrizes, retaining in the scar tissue numerous bacteria. These bacteria possessing attenuated virulence are, nevertheless, susceptible of renewed vigor, especially at the time of an operative traumatism, such as may be necessitated by a secondary closure. It is for this reason that it is essential to diminish the infection and to treat it as early as possible. If primary suture has not been accomplished, through impossibility or failure, it is necessary

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to employ immediately an antiseptic method by means of which cicatizzation may be accomplished without latent microbism

It would be, indeed, a great mistake to accept as axiomatic that the primary closure must take the place of all the others. It is evident that where it is possible to practise it without danger to the patient it is of considerable benefit But we must not forget that this procedure is possible only in certain periods of warfare When the wounded are not very numerous—that is, if an attack is to be made on a short part of the front—it is possible to forecast the number of wounded and to provide the necessary surgeons. But as soon as the number of wounded increases, due to the extension of the front or change to open warfare, it is impossible to perform the complete operation close to the front line It is then necessary to do only the minimum only to open the wounds, only to do hemostasis and to send the wounded to the rear Here we find again infected wounds at the acute period, and it is necessary to treat the infection before secondary closure. Thus one will see that the impossibility to complete the surgical operation at the front is not confined to times of retreat, but may happen even with an advance During the battles in Flanders last fall the British were compelled to follow this rule wounded, hastily operated on at the front, reached the base hospital in suppurating condition I was able to verify this fact at the base hospitals of Rouen, where the American units from St. Louis and Cleveland were working

We must not be asleep with too great an optimism and believe that infection is overcome

Great progress has been made since the simple opening and drainage of wounds to their complete excision and closure. But these primary and secondary closures are not always performed under the best conditions. We lack, even now, an effective test which will indicate, after an operation, whether the wound contains virulent or non-virulent bacteria, and whether or not we can safely close it

Technic I will not burden you with a very detailed technic for the surgical closure of wounds. It is done without special precaution when it is done early. I wish only to call attention to some new facts. Whatever may be the procedure employed the following precautions must be observed

- I The closure must be complete as much as possible If the suture is not complete there is reinfection from the exterior generally from the skin
- 2 The stitches should be without exaggerated traction. Tension of the stitches puts the skin in bad condition of defense against infection.
- 3 Under the cutaneous suture no cavity must be left in which secretions can accumulate The secretions accumulated in the cavity constitute a very good medium for the culture of the bacteria. There is, however, a procedure which banishes complications when suture is not absolutely complete or if there is reason to fear a hematoma (the hemostasis having been difficult) or if there is any oozing whatever. This happens often in the secondary closure of stumps with resection of scar tissue and bone ends. In these

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cases cutaneous suture is made as complete as possible, but one or two instillation tubes are left under the skin to sterilize the subcutaneous cavity by the Carrel-Dakin method without the necessity of removing stitches, if there is some inflammation after the operation

These diverse rules must be more strictly applied in the suture of old wounds made after a long period of suppuration. Indeed, the granulations contain bacteria (now attenuated but hable to be increased by the traumatism), and it is necessary to avoid the possibility of a new suppuration which would prevent success of the suture. Besides, these granulating tissues have made the walls of the cavity in the muscles rigid, and the suture of the skin will be insufficient to efface this cavity. Furthermore, the skin is extremely retracted and the surgeon is unable to close the wound completely without too great a tension of the stitches. We must then have recourse to a very simple procedure—namely, the corsetage of the wound for forty-eight hours before the operation.

This consists of the application on each side of the wound of adhesive plaster, along the edges of which, at intervals, are hooks. A rubber string laces this, thus bringing together the edges of the wound. Retraction of the skin is easily overcome, and in twenty-four to forty-eight hours the edges are in contact. The more or less intramuscular cavity is thus effaced, and it becomes possible to suture the skin without having to act on the granulating tissues wherein infection is most to be feared. To effect the suture it is sufficient to resect the epithelial line, to raise the edge of the skin 1 or 2 centimeters and to stitch after a precise joining of the edges.

Sometimes the granulations are so thick that it is better to curette them to diminish the thickness of the scar In these cases I prefer to operate twice (1) surgical resection of the scar, followed by sterilization with the Carrel-Dakin treatment, (2) closure, several days later, after sterilization

I had to treat a great number of extensive streptococcic phlegmons in Rumania last winter, which phlegmons I was able to sterilize by the Carrel-Dakin method and to close through the medium of an elastic corsetage These closures were made in one step in those cases which were under my care from the beginning—in two steps where the sterilization was begun after a long period of suppuration

Another difficulty may be encountered by the presence of a bone cavity, in order to close which it is necessary to begin filling it before the closure. We employed several procedures to fill these cavities, using several kinds of paste or transplanted fat-grafts. A new procedure recommended by my associate, Doctor Guillot, seems better than the others. It consists of closing the cavity with a flap of skin to which is adherent and appendant a flap of subcutaneous fat, the fat filling up the cavity, which is covered by the skin, sutured at the edge of the wound

There are, however, some cavities that we can close without filling These are the joints and the pleural cavity. The articular cavity is made to be permanent and the pleural cavity will be quickly effaced by the spon-

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taneous distention of the lungs We had this winter considerable experience with streptococci empyema, and all the cases treated before the period of rigidity of the walls of the infected cavity were successfully closed

I do not wish to prolong these details. I wish only to call attention to the fact that if we have made any progress in the treatmen of infected wounds it is because surgery has discarded empiricism, becoming more scientific through the acceptance of help from other sciences, such as biological chemistry, bacteriology and mathematics

The time is past when the appearance of the wound and the temperature chart were sufficient indicators to the surgeon of the evolution of a wound Something else is necessary. The bacteriological chart of Carrel and a complete bacteriological examination must enter into the practice. An antiseptic substance must no longer be judged by the color it imparts to the wound, but according to the real effect on the secretions on the dead or living tissues and on the germs which contaminate it

It is just to say that this evolution of surgery has been guided by the work of Carrel and Dakin

#### THE PHYSICAL FACTORS INFLUENCING INFECTION\*

#### By Walton Martin, MD

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I have used the word physical with the idea of discussing the relative importance of certain mechanical features which influence the initial lodgment and the persistence of infection. I have not had in mind the consideration of the effects of physical forces, such as light, heat or electricity, on the growth of microorganisms within the tissues

During the war the whole subject of infection has been studied under very special conditions. All the injuries by artillery projectiles and rifle and machine-gun bullets at close range are heavily infected, and, as we all know, this has been the usual type of injury in the warfare of the past three years.

If left to themselves or treated conservatively they regularly develop infection, often of a type and severity rarely seen in civil practice. The evolution of these lesions has been studied and methods of treatment suggested not only by surgeons whose work in civil life, in great industrial centres, has accustomed them to the treatment of infected wounds, but also by those trained in the technic of experimental laboratories, by pathologists and chemists. An intensive study has been made by these different groups and the whole subject considered from many fresh and stimulating points of view. But no essentially new surgical problems have been presented, attention has simply been turned from measures directed toward the prevention of the introduction of microorganisms after the wound is inflicted to means of combating infection already implanted. At the outbreak of the war the ruling idea was the avoidance of secondary infection.

It is common knowledge that pyogenic microbes are frequently introduced into the body without producing any pathological effect the tissues and are destroyed there by the activity of the body cells know that many accidental wounds are contaminated by pathogenic microorganisms and yet heal without evidence of infection Operative wounds are frequently soiled by bacteria in performing gastro-enterostomy, intestinal resection or in the removal of an infected appendix, and yet heal by Infection is uncommon in gunshot injuries seen in civil primary union practice made by bullets of low initial velocity Eighty-five per cent of the injuries from the pointed modern rifle bullets in the Japanese-Russian War healed without reaction according to von Oettingen i In all these injuries bacteria are introduced into the wound but the relation between tissue vitality and microorganisms is such that infection does not occur wounds are contaminated but not infected—that is, there is no clinical evi-

<sup>\*</sup>Read before the American Surgical Association, June 6, 1918

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dence of the group of reactional phenomena either local or general which we are accustomed to consider as furnishing evidence of infection shown experimentally that a few bacteria can be introduced without producing any effect, that larger doses cause local infection, whereas death regularly follows injection of very large numbers It is well known that bacteria have not a fixed virulence, and that their toxic action can be exalted or attenuated by a number of causes, but aside from the dosage and virulence of the microbes, and the susceptibility of the individual inoculated, there are certain factors purely mechanical which play a most important part in determining whether or not the microorganisms gain foothold in the tissue and multiply there and control their progress when they have become established in the tissue. That is the gravity of infection is regulated by a number of mechanical conditions which are realized anatomically in certain wounds and not in others These conditions are (I) pressure at the focus of infection, or point of initial lodgment, (2) foreign bodies, (3) devitalized and necrotic tissues, (4) dead spaces

It is well known that an open wound is infected with difficulty, whereas irregular wounds, punctures or lacerations are prone to infection. Obviously the welling up of blood and the outflow of blood and lymph must wash away foreign material. The ordinary pathogenic bacteria are non-motile. When they are brought in contact with the wound surface they can only find lodgment there, like any other foreign body, through some mechanical factor, as long as there is free flow from every part of the surface of, the wound they must be necessarily carried away. It is also evident that unfavorable conditions exist in the wounds open to light and air for the colonization of anaerobic organisms.

The question of the open wound and its relation to infection has been studied experimentally by Friedrich <sup>2</sup>. He amputated the tails of mice by a clean cut, then introduced the stumps into a virulent bouillon culture of anthrax and kept them there from five to thirty minutes. The animals all lived. In a second series he kept the wounded surfaces in the culture media for as long as three hours, then reamputated higher up. Three of these animals lived, in a fourth there was contamination during the reamputation and the animal died. All the control animals died after subcutaneous injection of the same culture in from thirty-four to forty hours. He concludes that even in susceptible animals highly virulent cultures of anthrax bacilli are unable to cause progressive infection if every possibility of creating local pressure and every mechanical adjuvant is removed.

The division of the different planes of tissue, skin, cellular tissue, aponeurosis and muscle, each with a different degree of elasticity and tensile strength, causes a shifting of planes one over the other, and this displacement of the layers is also brought about by any change from the position in which the wound is received. The deeper the wound, the nearer it approaches a puncture or perforation the more marked is the action, it reaches the maximum in gunshot injuries where certain parts of the track of the missile may

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be completely shut off Consequently the blood and lymph poured out from the severed tissues escapes only partially externally, a portion spreads out internally along the line of cleavage between the tissues. Foreign material introduced into the wound is then carried inward, not outward. The more irregular the wound surface, the greater the clefts and cevices, the less easily will bacteria be washed away by the lymph and blood. It must be remembered that even the surface of a clean-cut incised wound looks irregular and torn under the microscope, magnification of the blade of the sharpest knife shows a serrated edge and the severance of the body tissue by it inevitably causes irregularities large in relation to the size of the bacteria

By friction organisms are readily forced into the wound surface rapidity with which they are thus absorbed is well shown by the experiments of Schimmelbusch. He found anthrax bacilli in the viscera ten minutes after he had vigorously rubbed them into an incised wound in the tail of a mouse, nor did amputation at this time prevent a fatal outcome the pressure of blood issuing from divided vessels is usually sufficient to keep the pathogenic bacteria from entering the blood stream, and under ordinary conditions they start to grow, make toxins, cause tissue necrosis, determine a lymph flow and exert a positive chemotaxis A wall of leukocytes surrounds the focus of infection However complex the causes of these phenomena may be, whatever relation they bear to osmotic pressure or to chemotaxis, whether the cellular wall about the focus may be looked on as a semipermeable membrane, whatever the relation of the crystalloids and colloidal substances at the centre of the focus, we certainly know there is created about a nidus of infection an accumulation of fluids under pressure, and whenever this pressure exists there are clinical evidences of inflammation and the relief of this tension by purely mechanical measures is regularly followed by subsidence of the manifestations of reaction to infection, and so delicate is this relation that the slightest increase in pressure is followed by a recrudescence of the symptoms This is a surgical principle too well attested to discuss-it is the basis of all effort at wound drainage It is the fundamental idea in the open treatment of wounds

In wounds a mechanical barrier to infection is rapidly furnished by a wall of leukocytes arranged along the wound surface. At first, to be sure a delicate one and easily broken by trifling mechanical violence. Giani showed this experimentally. He soaked filter paper in a virulent culture of anthrax, then laid the piece of paper gently on the surface of fresh wounds two, six, eight, ten and fourteen hours after they were inflicted. Even at two hours a third of the animals survived and in the ones in which infection occurred he was able to recognize, by slight signs of hemorrhage, a break in the protecting wall of leukocytes. At fourteen hours all recovered

It has also been shown that even if bacteria become established and start to grow on an open wound surface, and there is no mechanical violence or pressure from without, their growth remains on the surface for a number of hours and can readily and certainly be removed by purely mechanical means

#### PHYSICAL FACTORS INFLUENCING INFECTION

Friedrich<sup>5</sup> contaminated fresh wounds in mice with garden earth and street dust, then excised by a clean cut the surface tissue of the wound to the depth of the 2 mm, using a sharp knife and taking care not to touch the fresh wound with instruments that had come in contact with the contaminated surface. Animals in which the excision was done within six hours, all recovered. Those in which the excision was done after ten hours, all died. Those done at seven hours showed marked signs of local infection, but finally recovered. After excision the wounds were left open. The prevailing organism was the bacillus of malignant edema. Controls died without exception in a short period of a type of gas gangrene.

Local pressure then has been proved experimentally as well as practically to be a physical factor of great importance both in the initial lodgment and in the persistence of pathogenic bacteria in the tissues

Undoubtedly foreign bodies introduced into the tissues act unfavorably on the vitality of the surrounding cells. They act as both mechanical and chemical irritants. They seem to make it difficult for the bactericidal forces of the body to kill the microorganisms implanted with them. Gaffsky,6 however, concludes an article on the relation of foreign bodies to infection with the statement that they exert, as a rule, very little influence. He can hardly mean on the persistence of infection

But the main significance of the foreign body is as a vehicle or conveyer of infection; it is a most effective means of carrying microorganisms into the tissues and lodging them there. Particles of earth, splinters of wood, fragments of glass, soiled and contaminated, are frequently embedded in the tissue. In gunshot injuries fibres and particles of soiled clothing, surface dirt, all manner of small objects are violently forced into the tissues, each with its modicum of infection. These bodies are more or less anchored in the tissues—the flow of lymph and blood is incapable of carrying them out

How widespread is the fixation of infected foreign bodies in the tissues in gunshot injuries was pointed out by Muller<sup>18</sup> and Koller<sup>19</sup> They showed by experiments in wounds by high velocity modern rifle bullets that fibres of clothing were forced into the sound tissue surrounding the track of the missile, and it was possible to disinfect the track with caustics or the actual cautery

In June, 1915, Policard and Phélip<sup>7</sup> made an interesting report on the histological and bacteriological findings about infected foreign bodies. They had studied and analyzed the biological processes of attack and defence about fragments of clothing introduced into the deeper tissues by shell fragments at periods varying from an hour and a half to three days after the wounds were inflicted, and the number examined had been sufficient to enable them to follow the evolution of the lesions. The blood from severed vessels is poured out about the foreign bodies at the time of the injury, it rapidly coagulates, obeying the well-known physiological law. This coagulation is often so rapid that the centre of the wad is soaked with clear serum not impregnated with fibrin. Each fibre is glued in coagulum, and a sheath of

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coagulated blood is formed about each foreign body, in this enveloping mass the bacteria brought in on foreign-body fragments begin to germinate and the tissues about them here first show signs of reaction. This reaction appears from the fifth to the ninth hour approximately. From the ninth to the twelfth hour one begins to recognize the appearance of microorganisms having the characteristics of the Bacillus capsulatus aërogenes. From the twelfth hour three related phenomena appear and progress simultaneously

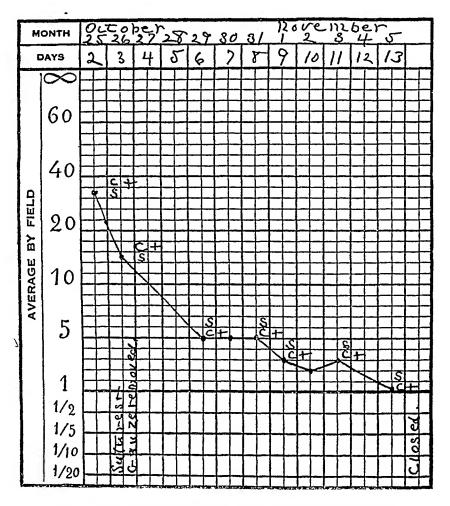


Fig i -Dog Infected foreign body removed Wound closed in nine days

The bacilli multiply, at first about the foreign bodies; they radiate more and more from these as centres of infection. Second, there is an afflux of polynuclear leukocytes. Third, the leukocytes are transformed under the action of bacterial toxin into pus cells. These phenomena at first progress slowly, then with ever-increasing rapidity.

If infection is established about a foreign body it has an extraordinary tendency to persist, and the removal of the foreign body causes this persist-

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ent infection to cease A sinus of months' standing rapidly closes as soon as the foreign body is extracted

Miss Clarke, at the experimental laboratory of the College of Physicians and Surgeons, has kindly prepared for me a chart which illustrates in a graphic manner the fall in the number of bacteria after the removal of the foreign bodies. These foreign bodies are swarming with millions of organisms, when they are removed the body finds little difficulty in overpowering those that are left

Foreign bodies then are most important factors in implanting infection, and in causing it to persist in the tissues

After every injury there is a phase of cellular shock, there is a period of time following the injury when there is a paralysis of all cellular activity It bears a direct proportion to the degree of the initial violence The defensive power of the cells, their capacity for resistance, are held in abeyance during a varying period. The vitality of the cells is interfered with in some After an incised wound this period is of short duration After the violence exerted by hurling into the tissue a jagged fragment of shell casing it is prolonged for several hours Poincard and Phélip found that wounds examined three or four hours after they were inflicted had the same appearance as those examined a half-hour after the injury. The phenomena of reaction were not only slow in appearing but always of slight intensity A lowering of cellular vitality and its effect on lessening tissue resistance has been experimentally demonstrated by Roger and Josué 8 They ligated the femoral or iliac artery in ten rabbits, then inoculated their legs with various pyogenic organisms The controls all showed a small well-circumscribed abscess On the other hand, in the animals where the arteries were ligated, there was extensive swelling of the entire leg and at autopsy all the evidences were found of a diffuse spreading infection

In every injury there is not only interference with the vitality of cells, but there is cellular death. Here again the amount of necrosis has a direct relation to mechanical violence, and has an important relation to the initial lodgment of bacteria and to their persistence in the tissue. Linser® studied the influence of mechanical damage to the tissues at the point of initial lodgment in labbits. He used staphylococci, streptococci and tetanus spores. He laid the muscle bundles of the abductor bare, then covered them with moist compresses. These animals were used as controls. In a second series of animals portions of the muscle were tied off, or allowed to dry by long exposure to the air or violently crushed. In the controls infection did not take place. In the second series a progressive and fatal infection resulted.

Certain organisms, like the tetanus bacillus and the group of anaërobic bacilli, which produce gas gangrene, are, in a measure, saprophytes, that is, they do not gain foothold in the tissue and multiply there unless there is a certain amount of necrotic tissue. Thus aside from the fact that most microorganisms find a favorable medium in necrotic tissue, a group of bacteria are only pathogenic when this medium is present. Moreover, some of

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these, like the bacillus aërogenes capsulatus, seem to need a special form of necrotic tissue, they only flourish on dead muscle

That the mechanical removal of all necrotic tissue, especially all dead muscle tissue from a contaminated wound, prevents gas gangrene has been definitely shown, and still more interesting is the fact that the disease can be arrested when established by the resection of the muscle or the group of muscles involved up to a point where the color and contractability of the muscle are normal and the blood supply good. Frankau, Drummond and Neligen<sup>10</sup> reported a year ago a number of cases treated successfully by this method

In every wound the necrotic tissue must eventually be disintegrated and eliminated before healing can occur, so that the excision of the necrotic tissue along the track of the missile is only the removal mechanically of material which would eventually slough. The limitation of this removal to 2 mm, as given by certain writers, is obviously misleading. The rule given by Sencert<sup>11</sup> or H. M. W. Gray<sup>12, 13</sup> to cut away the tissue until there is a fresh bleeding surface seems to be generally accepted, for the amount of tissue damage bears a relation to violence inflicted. In an injury from a projectile it must depend upon the mass and velocity of the missile

The elimination of the necrotic tissue from a wound is brought about to a very limited extent by autolysis. It is accomplished by the energetic proteolytic enzymes furnished by living leukocytes and set free by their destruction In an infected wound the bacterial enzymes play a most important part in this elimination, but the products of their activity are proteoses, ptomaines and a row of decomposition products harmful locally and when absorbed A morsel of necrotic tissue in an infected wound contains thousands of organisms and it is these nests of bacteria which are so frequently responsible for persistent infection. When they are cast off or removed the wound If one were to count the number of bacteria and chart ımmediately heals them from an ordinary boil, I feel sure that there would be a most astounding fall with the elimination of the slough or necrotic core and the base line of one or two to a field would be reached six or nine days afterward ferent tissues have a varying degree of resistance to dissolution connective tissue, blood plasma, lymph and muscle are rapidly destroyed, aponeurotic tissue and tendons are still less so, and bone is most resistant separated from the living tissue, swarming with bacteria as a focus of infection, may remain for years in the tissue

Kenneth Taylor<sup>14</sup> has given the bacteriological findings in sequestra. He always found them infiltrated with bacteria. When the sequestrum is removed there is rapid healing, the closure of a long standing sinus

Tissue necrosis, then, furnishes a suitable culture medium for bacteria, permitting them to flourish and multiply in the tissues Devitalization of cells makes them react slowly Foci surrounded by devitalized tissue are poorly defended

In accidental wounds due to the different contractability of the tissue

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planes and their displacement there is a tendency toward imperfect approximation of the walls of a wound. Dead spaces are readily formed. Even in operative wounds, if the entire area about the incision is removed and examined after what appears to be most painstaking apposition these spaces are frequently seen. If hemostasis has been exact they are filled with lymph. In bleeding wounds they rapidly fill with blood. In irregular lacerated wounds they are much larger and form stagnant pools of fluid in the tissues. Now although freshly shed blood and lymph are bactericidal this property is rapidly lost. Blood furnishes an excellent medium for bacteria. Dorst has studied this disposition of hematoma to infection, he found that it was increased about forty-fold for the staphylococcus.

Long-continued infection, with imperfect drainage, together with rigid and unyielding scar tissue, frequently causes uncollapsible spaces, which do not disappear when the fluid within is evacuated. Whenever the exudate is removed there is a contraction to a slight extent of the cavity and a tendency to the closure of the orifice on the surface. Then again the fluid collects, the process repeating itself indefinitely until, by some mechanical means, the unyielding wall is obliterated. Such cavities are seen in chronic osteomyelitis. The most striking example is furnished after the imperfect drainage of the pleural cavity. By simply creating different anatomical conditions, by destroying by surgical operation the infected dead space either by removal of the outer wall, or the unyielding cicatrix holding down the elastic pulmonary tissue, the long-standing infection is arrested, and the old sinus closed.

Dead spaces furnish favorable conditions for the growth and persistence of bacteria in the tissues

I have presented this paper with a certain diffidence. The reference to principles so generally recognized and so long known seems banal. I imagine the relief afforded and the prompt healing that follows the extraction of a splinter of wood or a sharp piece of flint from a festering wound must have attracted the attention of men of the Stone Age. If we could examine the rolls of papyrus from the great library at Alexandria, how many references might we not find to foreign bodies, imprisoned discharges, separation of slough and persistent fistulæ "Recent ulcers (infected wounds) will be least exposed to inflammation if the matter is not prevented from escaping at the mouth of the sore," wrote Hippocrates, and Celsus in his chapter on extraction of foreign bodies writes, "A third kind of weapon which requires sometimes to be pulled out is a leaden bullet, or stone or some such thing. In all these cases the wound must be enlarged and what is within must be extracted." This is said to be the first mention of leaden bullets, there is no record of the nature of the weapon used for hurling them into the tissues

I have referred to these principles, however, endeavoring to place a juster emphasis than is sometimes done on the various factors entering into the treatment of infection. All treatment is dependent on these principles, they are fundamental. No one believes, as far as I know, that one can

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disinfect with a chemical only a wound from an artillery projectile. Yet by the application of these principles the excision of all necrotic tissue, the removal of all foreign bodies, apposition so carefully made that there are no dead spaces, the avoidance of tissue tension by exact hemostasis, these grossly contaminated lacerated wounds are converted to clean incised wounds, and many of them may be closed by suture successfully

In the Surgical Conference of the Allies<sup>18</sup> last November it was said that the disinfection of the wound had passed from the domain of the chemist to the domain of the surgeon, primary suture had taken the place of secondary suture and had become the method of choice General Bowlby, in March of this year, pointed out that these principles were first recognized as advantageous for the knee-joint, then for head, lung and abdomen, and finally for the extremities

If the infection is well established when the wound comes under treatment, here again these are the guiding principles, the foreign bodies must be removed, necrotic tissue excised, sequestra extracted, every pocket and irregularity laid open to establish drainage. After this is done and the wound flushed by an antiseptic of a certain concentration, for a certain time, and if the bacteria still persist in spite of the treatment, Carrel<sup>17</sup> writes they indicate the presence in "the deeper parts of the wound of foreign matter, such as shreds of clothing, fragments of projectile, splinters of bone or morsels of necrosed tissue." In other words, if at the original mechanical operation there has been a failure to carry out these fundamental principles the antiseptic most rigorously applied is unable to overcome these unfavorable physical factors

Is a young surgeon about to go to France to treat infected war wounds likely to appreciate the relative importance of the excision of the necrotic muscular tissue about the track of the missile, if he reads that the first stage of treatment consists in mechanically preparing the wound for the penetration of the antiseptic? Is he more likely to have a just idea of the treatment of infected wounds if he reads two hundred pages on the application of the antiseptic and five or ten lines on these fundamental principles? Is there not danger of converting certain of the admirable technical methods into a ritual, and is not the stress on the unessential one of the predominant characteristics of ritual? I am far from depreciating the application of antiseptics, the rough bacteriological control of infected surfaces, the scrupulous cleansing of the margin of the wound, the avoidance of injury to the granulating surface, the study of the rate of healings by the interesting indices of cicatrization of du Nouy, and the importance of avoiding secondary infection

But the essential factors, both in the initial lodgment of bacteria and their persistence in the tissue, are the relief of tissue tension and pressure from without, the mechanical elimination of necrotic and devitalized tissue, the removal of foreign bodies, the avoidance of stagnant fluids in dead spaces and the obliteration of uncollapsible cavities. The enormous experience

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in the treatment of infected wounds gained in this great war has proved it without question

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Surgical Treatment A Practical Treatise on the Therapy of Surgical Diseases for the General Practitioner and Students of Surgery By James Peter Warbasse, M.D. Volume I, pages 947 Philadelphia W.B. Saunders Co., 1918

The rapidly enlarging demands of Surgery find an excellent demonstration in this portly volume of nearly one thousand pages, and with 699 illustrations. The volume is the first one of a series of three, all of which are to be devoted to surgical treatment alone. The author says that his object is to place in the hands of the surgeon the means for rendering help in every surgical condition under all circumstances, his aim being to make this information easily accessible and its application practical. He has laid us all under obligations by bringing out a book so full and elaborate, in which he has indicated his judgment as to the value of the infinite number of surgical procedures which the last thirty years has crowded upon the attention of the surgical world

The illustrations, which are very numerous, are of the kind which really illustrate, not merely embellish. Take the series of cuts which illustrate the subject of lumbar puncture, pages 156 to 159, or the treatment of infected wounds, pages 238 to 246, and one will appreciate the value of good illustrations.

The book naturally begins with a statement of the general principles of surgical treatment and a discussion of surgical materials. Then after a chapter on anæsthesia, he proceeds to the consideration of wounds and their complications, and then proceeds to the general body tissues

In the chapter devoted to the blood and blood-vessels, a full consideration of the various methods of transfusion is given. At the close of the discussion he records his personal opinion that the most simple, useful and effective method of transfusion is the citrate method.

A brief chapter devoted to the lymphatic system precedes those upon the diseases of bones which in their various phases, including fractures and dislocations, comprise a very considerable portion of this volume

In the remainder of the volume the muscles, the skin and the nerves receive attention. A full index closes the volume

The author's style is clear, his descriptions are exact and brief, his judgments are in general to be relied upon, and disclose the results of a naturally critical, judicial temperament brought to bear upon surgical problems, to the study of which large opportunity and long experience add weight to the final judgment

THE SURGERY OF ORAL DISEASES AND MALFORMATIONS Their Diagnosis and Treatment By George van Ingen Brown, DDS, MD Third edition, octavo, pages 734 Philadelphia Lea & Febiger, 1918

The rapidly succeeding editions of this book indicate the value which has been placed upon it by the colleagues of the author

The general surgeon will be especially interested to see how a large number of the conditions which he has been in the habit of considering as belonging to his domain appear when approached from the viewpoint of the man whose primary training was that of a dentist

Thus, in the chapter devoted to diseases of the nervous system affecting the buccal region, a very full and satisfactory consideration of trigeminal neuralgia is given. With regard to the pathology of this terrific and inveterate affection the paragraph devoted to the relation of the teeth to a certain proportion of cases given by the author is interesting He says pathological alterations which might be accepted as being distinctively representative of neuralgia of the fifth nerve are indefinite. Certain changes in Gasserian ganglia which have been removed have been demonstrated by Cushing, Spiller, and others, but, while it is recognized that trigeminal neuraigia may be due to central causes such as disease of the pons, hemorrhage, softening, multiple sclerosis, tumor, or abscess, through which the Gasserian ganglion or the fifth nerve may become involved, it is also caused by peripheral irritation, and in these cases pathological manifestations might be confined to affected branches of the nerve, and the Gasserian ganglion would probably not give any indication of pathological structural alteration Certain changes, however, which take place in the pulps of otherwise normal teeth, in these cases lend color to the belief that there is always structural alteration in the nerve or its affected branches in greater or less degree, and that in the course of time, with progress of the disease, other more remote portions of the nerve undergo similar degenerative changes Gordon believes that peripheral nerve degeneration is constantly present, and that this degeneration assumes the form of a neuritis which secondarily involves the Gasserian ganglion"

The dental aspect of trigeminal neuralgia naturally receives more full consideration than will be found in any general surgical treatise

A novel idea to most surgeons will be the relation of what the dentists call tooth grinding to the development of affections of the branches of the trigeminal nerve. True, the author shows that cause and effect are so closely interwoven that it is practically impossible to differentiate between the two with sufficient certainty and exactness to warrant definite distinction. The author is of the opinion, however, that given any local or general excitant which may give rise to the habit of grinding or clinching the teeth at night, we have at once a factor capable of exercising most potent influences in the production of pain in the head. These he describes as follows—

"The continued activity of the muscles of the jaws prevents perfect rest and is fatiguing in much the same sense as eye strain, with this difference,

however, that the ocular muscles are only active when the eyes are in use, whereas the activity of the jaw muscles, when the habit is fully formed, continues both day and night

"The continued overuse of the teeth in this way gives rise to certain changes in the pericementum, the vessels and the nerves surrounding the apical ends of the roots of the teeth involved and the cementum of their roots. This may be in the nature of a chronic pericemental hyperæmia. This congestion can and does cause pressure upon the nerve filaments as they pass from the end of the root of the tooth to join the main branch of the nerve, which in neurotic individuals is amply sufficient to set in motion very serious painful conditions. Perhaps the most serious of all pathological changes that take place in the structures surrounding the roots of the teeth, as a result of this tooth-grinding habit, is the tendency of the roots of such teeth to be ankylosed. With the disappearance of the pericementum in the process of the development of the ankylosis, there results constriction of the little nerve fibres which during the periods of the attack are capable of giving rise to the most excruciating exacerbations of pain."

In the matter of surgical methods of treatment in trigeminal neuralgia, the Hartley-Krause and the Cushing methods for removing the Gasserian ganglion are described in full. Avulsion of the sensory root only (Spiller's operation) is not mentioned. Frazier claims for avulsion the following advantages. It is easier of execution than any other, it subjects adjacent structures to no risk and it is attended with a smaller percentage of corneal complications with a lower mortality.

Diseases of the maxillary sinus and diseases of the tongue each have a chapter Malformations of the lips and of the palate naturally receive full consideration and abundant illustration Tumors of the jaws, resections and fractures, and affections of the temporomandibular articulation are very satisfactorily considered

The book is concluded by a chapter devoted to the treatment of gunshot wounds and fractures of the face and jaws under war conditions. As a whole, the book is an excellent presentation of the field of surgery which it undertakes to cover

The Spleen and Anæmia Experimental and Clinical Studies By Richard Mills Pearce, M D, ScD, with the assistance of Edward Bell Krumhaar, M D, Ph D, and Charles Harrison Frazier, M D, Sc D Octavo, pages 419 Philadelphia J B Lippincott Company

This book is in three parts the first part, which is devoted to experimental and laboratory work, is by the senior author, Doctor Pearce These chapters record the result of studies carried out in the Department of Research Medicine of the University of Pennsylvania The second part is devoted to clinical observations by Doctor Krumbhaar and contains clinical studies of the splenomegalies and their resultant anæmias, and also the

results of splenectomies A final chapter by Doctor Frazier is devoted to the surgical treatment of lesions of the spleen

The laboratory experiments were performed upon dogs. The most important changes after splenectomy performed upon a normal animal are found to be (1) a varying degree of anæmia, (2) increased resistance of the erythiocytes, and (3) lessened tendency to jaundice when hæmolytic agents are administered. Less frequent results which follow the procedure are (4) destruction of erythrocytes by the endothelial cells of the lymph-nodes and the liver, and (5) transformation of the marrow of the long bones from a yellow to a red marrow. In many instances, the anæmia develops almost immediately and progresses gradually until about the end of the first month, when it reaches its point of greatest severity. The return to normal then begins and a blood condition similar to that before splenectomy is reached after two and a half to three months

The changes following splenectomy in man, however, for the relief of diseased conditions is an entirely different matter. The removal of the spleen is always done in the presence of a more or less profound anæmia. The changes following this operation are not those resulting from the removal of a normally functioning organ, but those resulting from the removal of a source of hæmolytic or other toxic activity for which the altered physiology of the spleen is responsible. It is at this point that the clinical observations of Doctor Krumhaar come in, by whom the various forms of splenomegaly, Gaucher's disease, Banti's disease and von Jaksch's disease, hæmolytic jaundice and pernicious anæmia are in turn considered. The methods of study described form a valuable index to the possibilities of the clinical laboratory

With regard to therapeutic measures in the anæmias of splenic origin, there are two that stand out as the chief, almost the only, sources of hope, namely, blood transfusion and splenectomy. While it remains undeniable that in a very large proportion of cases no permanent benefit results from repeated transfusions, nevertheless the evident benefit which has followed it in some cases occurs sufficiently often to constitute an indication for its use as a matter of routine in all such cases, especially since simple methods of technic have removed from the procedure of blood transfusion much of the dangers and difficulties formerly attending it. Transfusion is presented as the main hope in cases of pernicious anæmia.—First, previous to operation in order to get the patient in the best condition possible for the removal of the spleen, and after operation to increase and render permanent its effects

As to the value of splenectomy, proper and careful study of the results which have been reported and collected from various sources show that there has been a real curative action in a limited number of cases, although the number is not sufficient to create much operative enthusiasm. Thus, as to the results of splenectomy in pernicious anæmia, the conclusion is that, although a few have continued in good condition for more than two years after operation, in no case can it be said that a cure has been effected,

for the blood of these individuals continues to show many of the characteristic signs of pernicious anæmia. It is true that many individuals show improvement shortly after operation, but of these a very large number fail to maintain this improvement and die in relapse or from intercurrent disease. Nevertheless, the temporary improvement that does follow splenectomy in the majority of cases and the long continued improvement that follows in the minority suffice to make splenectomy not only a justifiable operation, but in many cases an advisable one. It is a point of wisdom, however, that in no case can a cure be promised and in any case the operation should only be undertaken under the most favorable conditions. Experience has shown that the best results are obtained if the operation is preceded by one or more transfusions and those patients who relapse after operation may still be greatly helped by transfusion

With regard to Banti's disease and the hæmolytic jaundices, splenectomy should certainly be given careful consideration, for in many cases the results have been so excellent as practically to have amounted to a cure

The chapter by Doctor Frazier upon the operative technic is illustrated by a series of unusually fine plates

The book as a whole forms an interesting example of the collaborative work of modern medicine and surgery

BLOOD TRANSFUSION, HEMORRHAGE AND THE ANÆMIAS By BERTRAM M BERNHEIM, AB, MD, Instructor in Clinical Surgery, The Johns Hopkins University Octavo, pages 259 Philadelphia and London JB Lippincott Company, 1917

The interest of Doctor Bernheim in the surgery of the vascular system is well known. The present volume is the further development of his chapter on blood transfusion in his book on the "Surgery of the Vascular System," already published. The rapid development of the field occupied by blood transfusion during the past few years is exemplified by the enlargement of the author's chapter into this interesting and valuable book, although the extensive use of blood transfusion as a part of the methods of the military surgeon in the treatment of the wounded in war had not entered into the conception of the author when he sent his book to the press only a year ago

Every surgeon is interested in the extensive literature on the subject which the past year has accumulated. For this reference should be made to the literature given by Doctor Alexander Primrose at the close of his article on the "Transfusion of Blood in War," published in the August issue of the Annals of Surgery

The author is quite justified, however, in the historical note with which he prefaces his book. It is as follows

"The procedure of blood transfusion has evolved in successive stages from an undertaking of the most difficult and dangerous character, resorted to upon the rarest occasions, to a procedure of such simple and harmless character that it is utilized throughout the civilized world many, many times

each day Hundreds of people have been saved from premature death from hemorrhage, and the number of conditions in which it is utilized for therapeutic benefit is constantly increasing. Still, we are only on the threshold of knowledge concerning the fundamental character of the procedure, and the uses to which it will eventually be put."

The indications for transfusion are clearly outlined. In the list given in addition to actual hemorrhage, there are included such hemorrhagic conditions as purpura hæmorrhagica, hæmophilia, and pernicious anæmia, leukæmia, for various infections, and for certain intoxications and poisonings. The list is concluded by simple anæmia from any cause

The dangers of transfusions, particularly those due to hæmolysis and agglutination, are fully considered and the questions which must be answered in the selection of a donor for transfusion. An appendix is devoted to the tests by which one may determine the propriety of the use of any particular specimen of blood to be infused into a particular recipient.

After a full discussion of various methods of transfusion, one is interested in the final conclusion of the author, which is that "no method and no instrument is comparable in facility and elasticity to the citrate method of transfusion Of late," he says, "I have used this method in preference to all others and venture to predict that within a few years all our cunningly devised instruments for transfusion will be of interest merely as curiosities" He says further that, "so far as can be determined, there seems to be little difference between the therapeutic action of whole blood and citrated blood " He says that "by repeated clinical trial he has proved that its use in all forms of bleeding is attended with the same happy results as is that of whole untreated blood" This conclusion, however, is qualified by the statement that a post-transfusion reaction, as manifested by a chill or fever, follows the citrate transfusion far more frequently than one with whole blood, and in cases where the donor's and recipient's blood match perfectly by every known test Violent chill and fever up to 103 degrees, or 105 degrees, is to be expected about twenty minutes after transfusion in about one out of every three or four cases, and minor grades of the same reaction occur even more frequently This, in his opinion, however, is of no consequence so far as the ultimate result is concerned, since it is unaccompanied by any blood destruction

In the application of the sodium citrate method, the blood of the donor is received into a sterile graduated glass containing 25 c c of a 2 per cent sterile solution of sodium citrate. While the blood is running into the receptacle, it is well mixed with the citrate solution by means of a glass rod. After 250 c c of blood have been taken, another 25 c c of the citrate solution are added. If more than 500 c c of blood are to be taken, a second glass container is provided, equipped in exactly the same manner. The author has not found it necessary to immerse the blood containing jar in hot water. The jar may be taken directly to the side of the recipient wherever he may be A vein of the recipient has already been exposed and a cannula fastened into

it to which is attached a small rubber tube leading to a suitable funnel or flask, the tubing being filled with saline solution until the blood is poured into the funnel above. In order to prevent sudden overloading of the circulation, it is advisable to stop the flow of blood from time to time by compressing the rubber tube. After the blood has been injected, the cannula is removed, the vein ligated and the transfusion ended. The whole procedure is conducted without any sense of haste, because the citrate of blood may be kept for many hours without danger of clotting.

So many are the possible conditions in which blood transfusion may be of advantage, and so simple have become the methods of its application that it appeals to the interest of every one that has to do with surgical conditions. The many questions which attend blood transfusion are most satisfactorily considered in this book.

A TREATISE ON REGIONAL SURGERY Edited by JOHN FAIRBAIRN BINNIE, AM, CM, FACS, Kansas City, Mo Philadelphia P Blakiston's Son & Co, volume 111

With the appearance of the third volume of this treatise on regional surgery is completed the surgical work undertaken by Doctor Binnie. This last volume is the best of the three. It is composed of seventeen monographs written by thirteen different surgeons. Many of the authors are well-known writers, as, for instance, Doctor Binnie himself, Dr. Edward H. Bradford of Boston, Sir W. Arbuthnot Lane of England, Sir Robert Jones of Edinboro, Dr. Howard Lilienthal of New York, Dr. Dean Lewis of Chicago Monographs written by any of these men would, if written singly, attract attention, and there is no detraction from the value of the writings of these men as grouped in book form under the editorship of Doctor Binnie

Nearly 150 pages are occupied by Doctor Lewis with the subject of diseases of the upper extremity. This chapter is extremely well done and is interesting and instructive reading. The chapter upon deformities and paralyses of the upper extremity by Doctors Bradford and Soutter is carefully written and very suggestive.

In Sir Arbuthnot Lane's chapter the use of a steel plate in the treatment of fractures of the patella is advised. The writer does not appear to recognize the importance of a suture of the lateral fascia on either side of the injured patella. It is common experience that a simple suture of the patella does not give such satisfactory results as a suture of the patella together with a repair of the torn fascia. It is possible by holding the fragments of the patella firmly in place by a suitable clamp to so suture the soft parts as to maintain contact between the fragments and ordinarily secure bony union. I am also surprised that Mr. Lane makes the statement that the open treatment of fractures requires little skill and entails no risk whatever if the surgeon maintains aseptic precautions. This statement if accepted as it stands is capable of doing great harm among the profession in general. The open treatment of fractures requires great skill and there are great risks attending its most skilful employment.

The articles by Sir Robert Jones are all fine He writes upon deformities of the lower limbs, congenital dislocations of the hip, and infantile paralysis. They read as if written by a man in active practice and of large experience and are valuable contributions. The chapter upon thoracic surgery by Lilienthal and Gerster is upon a subject which is developing rapidly and is an interesting brief statement.

On the whole, this volume is very suggestive in many particulars. It is impossible and inappropriate to attempt a detailed criticism of the several methods employed by so many different authors. Suffice it to say that the monographs are well written, interesting and full of suggestion. As the volumes stand they give to the reader the present status of each subject satisfactorily.

Charles L Scudder

Genito-urinary Diseases and Syphilis By Henry H Morton, M.D., Clinical Professor of Genito-urinary Diseases to the Long Island College Hospital 4th Edition, octavo, pages 807 Profusely illustrated St Louis C V Mosby, 1918

The regular appearance of new editions of this book of Doctor Morton speaks well for its value and timeliness. The author is a veteran teacher and practitioner in the field of urology. As genito-urinary surgeon to the Long Island and Kings County Hospital for many years, he has enjoyed unusual opportunities for observation in his chosen field. That he has made the most of these opportunities this volume shows. In each succeeding edition he has kept his book abreast of the advances in urology which the preceding years have made. The book is a most satisfactory presentation of the knowledge and teaching of urologists at the present moment. The large number of original illustrations which are presented add materially to the value of the book. The author's style is concise, his descriptions are clear, his methods of diagnosis are up to date, and the most recent advances in pathology are included in the new edition.

The tendency of urologists at the present time is to omit syphilis from their special field. Syphilis certainly, in its protean form, finds itself allied with almost every department of medicine. While it is frequently transmitted by genital inoculation, it is by no means necessarily so and in a very large proportion of cases is not so at all, all of which constitutes an excellent series of reasons why it should not be included in urology and should be relegated to a field by itself. Doctor Morton, however, still clings to the old methods and devotes a number of chapters to a fairly full discussion of the subject.

Modern Urology In original contributions by American authors Edited by Hugh Cabot, M D Philadelphia and New York Lea & Febiger, 1918

This book, on the whole, is a discussion of modern-day urology. A perusal of its contents convinces us that it is practically an impossibility for the general surgeon to master thoroughly the science of urology. He

may be proficient in operative technic, but the refinements of modern methods of diagnosis, with delicate instruments requiring skillful manipulation, demand a special training and constant practice

Syphilis, a specialty in itself, is quite properly not considered in this book. The chapter dealing with the history of urology in America is instructive and inspiring. American surgeons have played a most important part in the development of this exceedingly accurate science.

The chapter on cystoscopes is interesting, but would be much improved by a discussion of some modern instruments other than those devised by the author. The discussion of methods of diagnosis is briefly but ably handled. Every urologist, but particularly every general surgeon, should read it

Roentgenology of the urinary tract is not particularly well treated, and represents the author's opinions rather than a complete scientific discussion of the subject. The chapter on diseases of the penis also falls short in the same manner. Chapters dealing with the following subjects, however, are splended scientific contributions, rendering them valuable as references. Syphilis of the genito-urinary organs, anatomy, anomalies and injuries of the penis, genital ulcers, infections of urethra and prostate other than tuberculosis.

Diseases of the urethra in the female is a subject very little written about, but beautifuly discussed in this book. Stricture of the urethra is presented in a masterly manner, as are also the articles on the testicle, scrotum, hydrocele, hematocele, and varicocele. Infections of the testicle and genital tuberculosis, as well as the subject of "Tumors of the Testicle," are all ably written

All of the articles on the prostate gland except those dealing with sarcoma and calculus are masterpieces. It is unfortunate these two articles were not more complete. The several chapters on the bladder are well written and illustrated, as is the article on the ureter.

The kidney is particularly well discussed in every detail, except that chapter which has to do with anomalies, hydronephrosis, etc. The author of this chapter has evidently referred to the older books for a good part of his information, and instead of a scientific description we have an expression of personal opinions. The articles on bilharziosis and echinococcus have a similar tendency, but the remaining chapters represent a wonderful work of reference and are the last word on the subject.

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To the Editor of the Annals of Surgery

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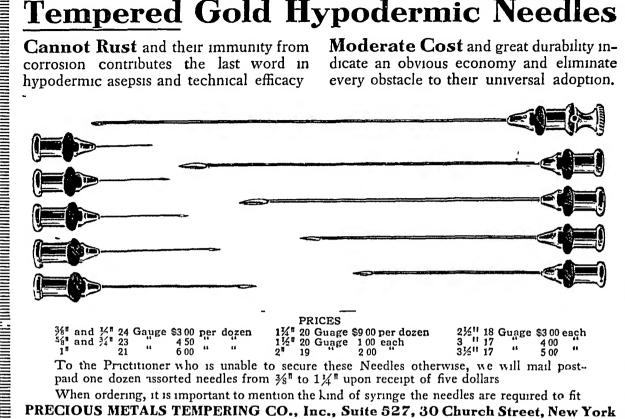
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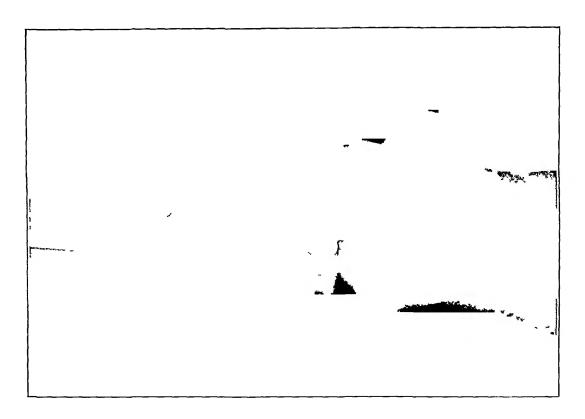
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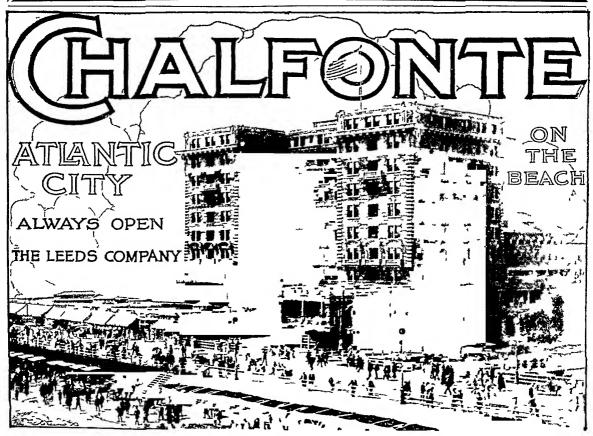
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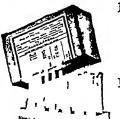
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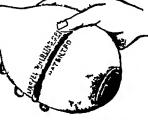
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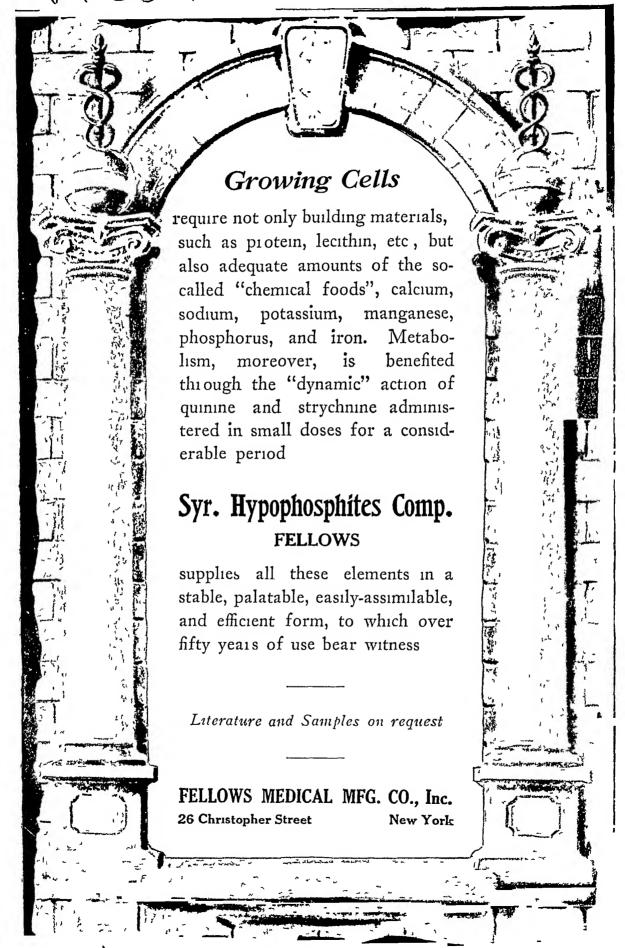
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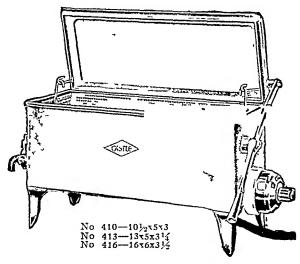
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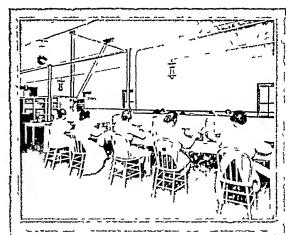
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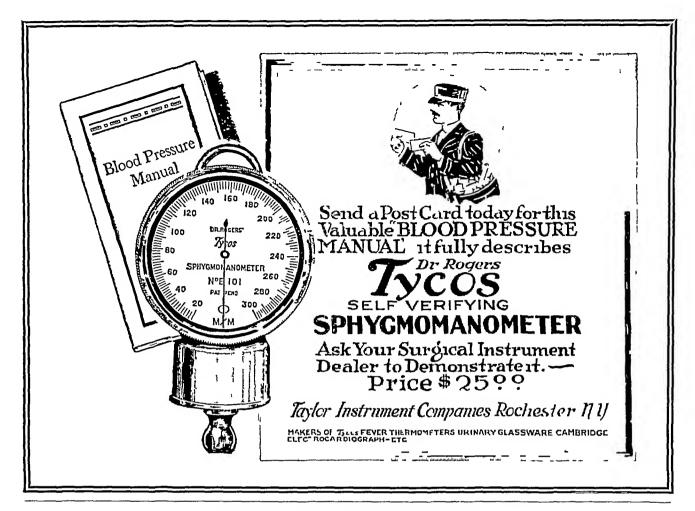
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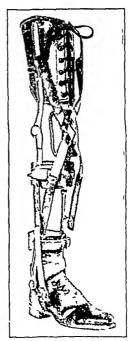
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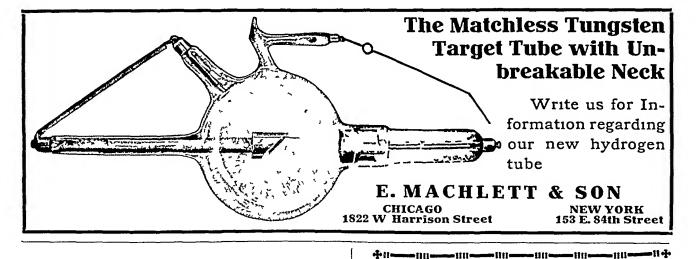
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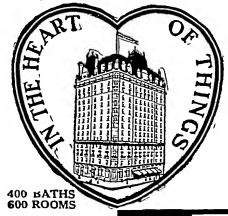
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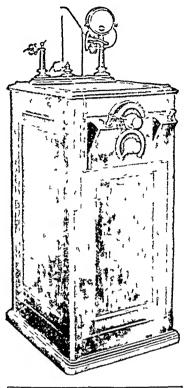
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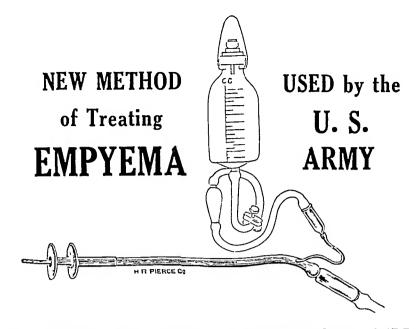
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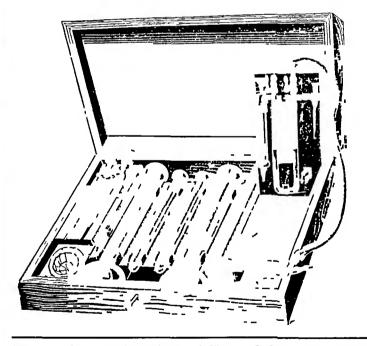


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Refer to Dr Landon's Article, Journal A M A, May 26, 1917

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# ANNALS of SURGERY

Vol LXVIII

NOVEMBER, 1918

No 5

# THE VALUE AND LIMITATIONS OF LABORATORY STUDIES OF ACIDOSIS IN SURGERY

By George W Crile, M D. of Cleveland, O

It has been suggested that acute blood acidosis and diminished reserve alkalinity may be a cause of shock. If this is true—if shock can be attributed to an increased acidity of the blood—then it would be logical to conclude that alkalinization of the blood would cure shock.

To determine the basis for these assumptions an experimental research was undertaken in my laboratory in 1912 by Dr M L Menten and later continued by W J Crozier, Ph D, and Drs W B Rogers, B I Harrison and R E Mosiman The laboratory studies, which included observations of the H-ion concentration and of the reserve alkalimity of the blood of different kinds of animals under varied normal and abnormal conditions, were supplemented by clinical studies of human blood under normal and pathological conditions

H-ION CONCENTRATION—Positive Laboratory Findings—In the work in collaboration with Doctor Menten, who had worked for a year with Michaelis and used his gas-chain method, we found that the H-ion concentration of the blood was increased (I) During intense fear, (2) during intense rage, (3) during extreme exertion, (4) during inhalation anæsthesia, (5) in surgical shock, (6) in hemorrhage, (7) in asphyxia; (8) in alcoholic intoxication, (9) several hours after excision of the liver, (10) near the death point after excision of the adrenals, (11) near the point of dissolution whatever the cause of death

Negative Laboratory Findings —We found also that the H-ion concentration was not increased (I) In narcosis by opium or its derivatives, (2) during sleep, (3) during protracted consciousness unbroken by sleep, until near the death point, (4) during the maintenance of artificial respiration in overtransfused decapitated animals, (5) in iodoform poisoning, (6) in serious, even fatal, diseases, such as infections, exophthalmic goitre, cardiovascular disease, typhoid fever

Morphine in Relation to Increased H-ion Concentration —When morphine in large doses was given during acute acidosis (indicated by increased H-ion concentration of the blood) the restoration of the blood to its normal reaction was interfered with, even prevented For example, heavy doses of

29

#### GEORGE W CRILE

morphine were given to a vigorous male cat, in which a markedly increased H-ion concentration had been induced by intense rage and struggling. The animal remained in acute acidosis for three and one-half hours and died in acidosis. In other experiments large doses of morphine interfered with the overcoming of the acidosis of inhalation anæsthesia. The ill effects of morphine in certain types of cyanosed patients is well known to clinicians. The exhausted and cyanosed patient should therefore not have morphine, but after the cyanosis has disappeared, morphine is most useful

In brief, we found that the H-ion concentration was increased in but two groups of cases (1) Those subjected to excessive energy-transforming activities in which, apparently, the corrective mechanism could not dispose of the increased acid by-products as rapidly as they were produced, and (2) those in which the sufficiently rapid elimination of the acid by-products was prevented by interference with the corrective mechanism

Reserve Alkalimity and Acid Excretion in the Urine —With the exception of the above note regarding morphine, no clinical lead of value was secured from our studies of H-ion concentration. We therefore turned our attention to studies of the reserve alkalimity of the blood with the hope that by this means we might secure a true indication of the reserve vitality of a patient, which would determine the surgical risk. To this end we made numerous measurements of the reserve alkalimity of the blood by the Van Slyke method, and in both the laboratory and the clinic we repeated the studies of Professor Lawrence Henderson on the acid excretion in the urine

Our experimental observations may be summarized as follows. In laboratory animals the reserve alkalinity of the blood was reduced and the acid excretion in the urine was altered in varying degrees by surgical shock, by anæsthesia, by infection, by asphyxia, by hemorrhage, by strychnine poisoning, by iodoform poisoning, by exertion, by emotion

Measurements of the reserve alkalimity afforded more accurate information when the animals were subjected to an acute overwhelming drive with which the corrective mechanism could not keep pace

The best estimation of the practical value of determinations of reserve alkalinity and of acid excretion was secured in the clinic. Here great and unexpected variations were found in acute infections, in late cancers, in desperate cases of exophthalmic goitre—in good and bad risks of all kinds. In cases of infection with grave prognosis which died later, and in other cases in which death was impending—not in the stage of dissolution but inoperable—the reserve alkalinity of the blood was sometimes found to be as great as in the observer, and the quantity of acid excretion in the urine was not materially disturbed

The results of these series of laboratory studies force us to the reluctant conclusion that these methods, despite their scientific interest, as yet offer meagre clinical value, that is, that laboratory studies of the H-ion concentration, the carbon dioxide tension and the reserve alkalimity of the blood

#### ACIDOSIS IN SURGERY

and of the acid excretion of the urine furnish no invariably reliable indication of the condition of the patient

Intracellular Acidosis —During the past ten years cytologic studies on over 2500 animals and on many humans have been made by my associates, especially Dr J B Austin The following notes summarize our cytologic findings

- (a) In all cases of exhaustion, whatever the cause, provided the animal lived from four to eight hours after an adequate degree of exhaustion had been established, fairly constant cytologic changes were present in three vital organs—the brain, the liver and the adrenals, the changes in the liver and in the brain being more marked than those in the adrenals
- (b) Our research included studies of exhaustion from insomnia, from the emotions of fear and rage, from muscular exertion, from physical trauma (surgical shock), from infection, from hemorrhage, from asphyxia, from acute alcoholism, from ether anæsthesia, from anaphylaxis, from eclampsia We studied exhaustion produced by the application of electric stimuli, by burns, by starvation, by the intravenous injection of acids, particularly hydrochloric acid, by excision of the liver, of the adrenals, of the thyroid, by the injection of foreign proteins, of fæces extract, of thyroid extract, of iodoform, of adrenalin, of strychnine, of chloretone. We studied also the exhaustion of salmon at the headwaters of the Columbia River in the spawning season, and of electric fish and eels after electric discharge. All of these studies were compared with parallel observations made on normal and on hibeinating animals

Our findings may be summarized as follows

- (a) The cytologic changes in the brain, the liver and the adrenals roughly parallel the clinical phenomena
- (b) When intracellular oxidation is excessive, as in extreme muscular exertion, intense emotion, physical injury, infection, after the injection of iodoform, strychnine, thyroid extract, etc., then an excessive amount of acid by-products will accumulate in the cell, and, as Loeb, Clowes, and others have shown, when the cell becomes acid it will accumulate water and swell and will take normal stain less well. If other conditions are normal, but there is a lack of oxygen, as in asphyxia, in hemorrhage, and after adrenalectomy, the physiologic balance will be disturbed, and a like swelling will occur. After the injection of an acid or the establishment of an acid state by chloretone, alcohol or ether, the cells swell. In brief, any one of the causes of exhaustion may produce the same end-effect—intracellular acidosis with a suspension of function according to the degree of exhaustion produced
- (c) The cytologic lesions produced by exhaustion from any cause are repaired only during sleep. If sleep is abolished, repair cannot take place, the cells remain acid, and death follows

Intracellular Problems —Since the balanced state of the cell is attained only during the normal supply of water and food, the rhythmic alterna-

#### GEORGE W CRILE

tion of consciousness and sleep, and normal oxidation, it is obvious that the solution of the problem is not as simple as the neutralization of the acidity of a fluid in a test-tube by pouring in alkalies. It is necessary not only to get rid of the acids, but also to establish the conditions required for continued oxidation within limits consistent with the maintenance of the life of the cell

Alkalinity and Acidity in Relation to Animal Life —The origin of life was probably in the sea. The sea is alkaline. Animal life is continued only in an alkaline medium. When the blood becomes acid, life ends. As transformers of energy, animals are constantly producing acid by-products. The acid by-products vary according to the rate of energy transformation, eg, they are increased by muscular exertion, by emotion, by fever, etc. Therefore the organism is constantly in danger of killing itself, and many animals and men have killed themselves by their excessive production of acid by-products. For example, in intense muscular struggles the acid-production is so great and so rapid as to overcome the factors of safety, ie, the lungs, the liver and the buffer substances—the reserve alkalies immediately available.

One would suppose, therefore, that during the vast selective struggles of animals, wide margins of safety must have been developed in these corrective mechanisms as a means of immediate protection against a sudden emergency,  $e\,g$ , the acute acidosis of muscular, emotional and fever crises. In the fluids and tissues of the body, also, have been stored large reserves of bases and alkalies to be more gradually drawn out in prolonged struggles, prolonged want of food and water, prolonged fever, etc

Our studies of the H-ion concentration of the blood supported this biologic conception, for we found that the factors of safety were overcome only by an intense drive, and that after the termination of the intense drive the normal H-ion concentration was quickly re-established, although clinically the animal was fatigued

LIMITATIONS OF LABORATORY METHODS—Our H-10n determinations, therefore, showed only the degree of failure of the corrective mechanism, but did not inform us to what degree the reserves had been called out, nor how wide was the remaining margin of safety

Estimations of the reserve alkalinity told us what reserves the blood contained at the particular time the estimations were made, but gave no information regarding the amount of reserves stored outside the blood—in the other body fluids and tissues

An attempt to secure information by these methods is comparable to an attempt to determine the wealth of a man by counting the ready money in his pockets (H-ion concentration), and from this amount estimating his ready available cash reserve in the bank (reserve alkalinity), and in turn estimating his ultimate financial resources from the amount of his bank balance, without taking into consideration the securities he might hold in his strong-box (ultimate reserves)

#### ACIDOSIS IN SURGERY

A man may be financially embarrassed if his immediate cash is expended, he is not bankrupt until his ultimate reserves are exhausted

So the scientific methods thus far devised give us the extent of the margin of safety in the blood at the moment the observation is made, but they do not inform us of the condition of the reserve factors of safety. In other words, our present laboratory methods do not tell the whole truth regarding the actual state of the patient

VALUE OF CLINICAL OBSERVATIONS—To what extent can we depend upon the clinical phenomena of acidosis as a means for estimating the reserve factors of safety? In this respect, what is the significance of changes in the respiration and pulse, of thirst, of pallor, of cyanosis, of collapsed facies?

Respiration —The respiratory centre consists of nerve cells and fibres, and these cells are modified by every phase of chemical changes in the blood. The respiratory centre, therefore, responds with infinite accuracy to every change in the acid content of the blood—is governed by the H-ion concentiation of the blood. This mechanism of surpassing fineness and accuracy not only reacts to intracellular acidosis but fulfils that function so correctly as to preserve life and health. Of such vital importance is its function that this delicate living mechanism is located in the seat of life itself, while the man-made laboratory mechanisms are not only infinitely more clumsy and inaccurate, but are outsides. The respiratory centre responds to every phase of acidosis—to the acidosis of asphyxia, of hemorrhage, of emotion, of exertion, of acid injections, of anæsthesia, of injury, of starvation—the entire gamut. It not only responds accurately, but its response is dramatically staged so that not only the trained professional eye, but the bystander, even the patient himself, cannot escape its obtrusive evidence.

The nerve cells of the respiratory centre are not the only nerve cells that are modified by acidosis, the cells that fabricate muscular and mental action are modified also, their power to do work is diminished. This is an essential protective adaptation, for if the activity of these cells were increased in proportion to the increase of the activity of the nerve cells of the respiratory centre, then the amount of muscular work and the consequent production of acid by-products would be increased, and certain disaster would result Hence we have increased respiratory action, and diminished muscular action—a corrective antithesis

Circulation —Why does the heart beat more rapidly in acidosis? The biologic interpretation would be that this reaction was evolved as a protective adaptation in order that the blood might circulate more rapidly and thus more efficiently serve those cells of the body whose activity is essential to life

The low blood-pressure, on the other hand, is not a corrective adaptation but, rather, it indicates the failure of the circulatory mechanism, which adds a damaging anæmia to the vicious circle of approaching disaster

Perspiration —Sweating is not only a corrective mechanism for the elimination of the heat incident to the increased energy transformation in exertion, emotion, etc., but it is also a vehicle for the elimination of the acid byproducts

#### GEORGE W CRILE

Thirst—The demand for water is an adaptation purposed to increase the supply of the most efficient means of diminishing acidity—water

Pallor—The patient grows pale because the circulation is failing and blood is no longer sent to the skin in excessive amounts as during the driving phase of excessive energy transformation in emotion, exertion, etc

Cyanosis — The nails become blue because the circulation is failing and the blood is not being oxidized

Collapsed Facies —Because of the loss of power of the muscles of expression, the features assume the appearance which is characteristic of exhaustion, and in varying degrees is seen in sleep, in anæsthesia, in death

Conclusions—As a result of these studies we are forced again to admit that no laboratory conclusion should be considered valid until it has been tested in the crucible of the clinic

In the problem of shock—exhaustion—the success of such restorative measures as oxygen, the intravenous injection of sodium bicarbonate with glucose and, above all, sleep—deep, untroubled sleep—lend support to the laboratory conception that acidosis—intracellular acidosis—is the fundamental condition present in exhaustion from any cause

#### THE HOSPITALS OF THE AMERICAN EXPEDITIONARY FORCE\*

BY COLONEL CHARLES H PECK, M C., U. S ARMY FORMERLY SENIOR CONSULTANT, DIVISION OF GENERAL SURGERY, A E F

THE care of the wounded from the trench or field to the front line hospital falls upon the Division Surgeon and his staff medical officers and enlisted men. Beside the Chief and his assistants on the Administrative Staff, these constitute the personnel of field hospitals, ambulance companies, Regimental and Battalion Surgeons for the regiments of infantry and artillery, stretcher bearers, ambulance drivers and hospital corps men

It is needless to say that much depends on the experience, foresight and judgment of the Division Surgeon. The choosing of sites for aid-posts and dressing stations, of routes of evacuation for the stretcher bearers and ambulances, instruction of officers and enlisted men, of ambulance companies and field hospital personnel in their duties, the perfecting of plans for rapid evacuating of wounded to properly equipped operating hospitals, the establishment of special hospitals for the care of gas casualties, are all of prime importance.

The fate of the wounded man depends first on the care and skill with which these duties are performed, and to perform his duty efficiently, the Division Surgeon must have the confidence and cooperation of his commanding line officer, and warning of impending attacks in order to make adequate, preparation. There must be an ample supply of surgical dressings and of splints at all aid-posts and dressing stations, and provision for applying heat and warm dry blankets in the treatment of shock. Splints must be furnished to stretcher bearers to apply to fracture cases where they fall. Each division in action should have an ample supply of the standard adopted splints, such as Thomas leg and thigh splints, Thomas arm splints and Cabot posterior wire leg splints, and all stretcher bearers and hospital corps men should be thoroughly instructed in their application.

Of the hospital corps men in the division about 60 per cent are available as stretcher bearers. These should be supplemented by additional combat men from each of the line regiments, designated and instructed to act as supplementary stretcher bearers in case of need during an offensive

The treatment of the wounded man from the time he falls until he reaches the evacuation hospital consists in the control of hemorrhage, the application of first-aid dressing, the application of splints, the treatment of pain and shock at the aid-post or dressing station (Fig I), by morphine, heat, hot drinks with bicarbonate of soda, and, if needed, blood transfusion or gum infusion, or rest for a time before being sent back in an ambulance, antitetanic serum must also be given. It is of the greatest importance

<sup>\*</sup>Read before the New York Surgical Society, October 9, 1918

that the wounded should reach the operating hospitals within eight or ten hours after injury, so that operation may be performed before infection has become established It is then possible in a good percentage of cases to prevent infection by careful débridement and closure of the wound by primary or delayed primary suture All war wounds, especially those due to shell fragments (generally at least 80 per cent of the total), are potentially infected, and unless the missile with fragments of clothing is removed and the contused tract excised, suppuration, gas gangrene, or serious sepsis in some form is almost sure to develop. If operation is delayed for twenty-four hours or more, it is necessary to leave the wound widely open and overcome the infection by the Carrel-Dakin treatment or some form of chemical disinfection, as a rule, closing the wound by secondary suture, when bacterial counts show it to be practically germ free This always means delayed convalescence, often increased scar tissue, and greater impairment of function, to say nothing of loss of life or limb from uncontrollable sepsis, as compared to results obtained by earlier operation

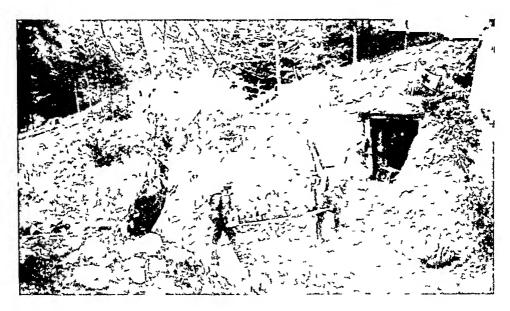
The importance, therefore, of a system of transport and evacuation of wounded and of properly equipped and manned operating hospitals near the fighting line, which will permit of early operation, cannot be overestimated

The field hospital is an integral part of the division, moves with it wherever it goes, and should not be used as an operating hospital for battle casualties, except in emergencies where it has been impossible to establish an operating hospital sufficiently near the line

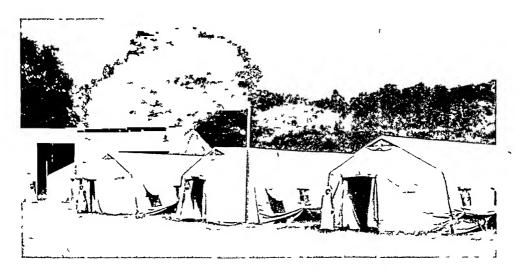
The field hospital should take care of the sick, contagious, minor accidents, neuroses, venereal and skin diseases. One of the four may well be organized for the treatment of gas cases, as has frequently been done, for provision must be made for handling large numbers of this type of casualty rapidly. Another may be used to supplement the capacity of a mobile operating hospital serving the division in time of stress, as was done in the 42nd Division during the July offensive near Chalons, and the 1st Division at Cantigny

The hospitals in which the vast majority of war wounds are operated upon are placed, as a rule, from 8 to 12 miles back of the line, and are not attached to a division, but rather serve a sector. They are of two types—(a) the evacuation hospital (the prototype of which in the French service is the H O E, in the British service, the casualty clearing station), and (b) the mobile hospital, or autochir of the French. The latter may be attached to and form a part of an evacuation hospital, or may operate independently as an advanced hospital for non-transportables.

For more than two years, up to the spring of 1918, the French had been developing a highly organized line of evacuation hospitals (Figs 4 and 5), from west of Compeigne to the Vosges, many of which had a capacity of from 2000 to 3000 patients. They were furnished with the best of surgical equipment, and manned by the ablest operating surgeons in France. The permanent staff of these hospitals was supplemented, in time of battle, by large



 $Fig \quad i \stackrel{}{-\!\!\!-\!\!\!-} Battalion \ aid \ post \quad Underground \ in \ a \ forest$ 



Fic 2 — Mobile Hospital No 2 A E F showing Bessonneau tents (capacity 200)

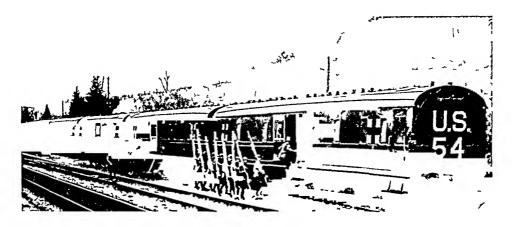
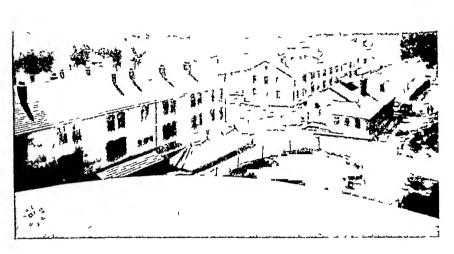


Fig 3 —New hospital train, A E F (sixteen cars capacity 350 to 550 patients)



 $\Gamma_{1G}$  4 —General view of Evacuation Hospital No 2 A E  $\Gamma$  Two story military barracks (capacity about 1000)

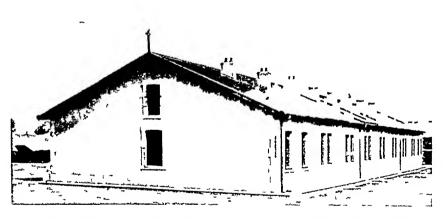


Fig. 5 —A ward building of Evacuation Hospital No  $_{\rm I}$  A  $_{\rm E}$  F  $_{\rm I}$  One story military barracks (c spacity about 1000)

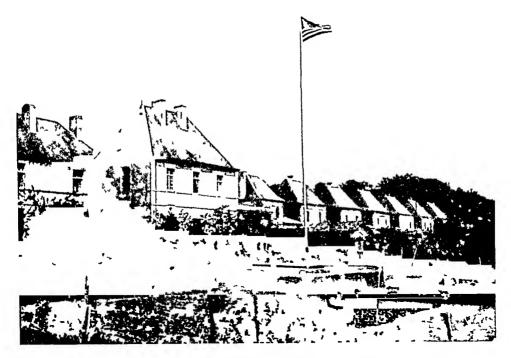


Fig 6 -Old monastery, now occupied by Base Hospital No 3 A E F (capacity about 1700)



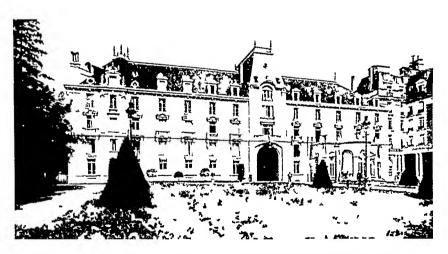
 $\Gamma$  ig 7 — Partial view of Base Hospital No 15 A  $\Gamma$   $\Gamma$  Artillery barracks two story type (capacity about 2500)



Fig. 8—Base Hospital No. 6, A. E. F. Group of newly built barracks for expansion main hospital in an old school building (capacity 2200 beds)



 $\Gamma_{IC}$  9 —Base Hospital No 27 A E  $\Gamma$  Old college building and courty and (capacity about 2000)



I ig 10 —Base Hospital No 36 A E F One of five summer hotels used by hospital (espacity about 1800)

numbers of mobile operating teams, which were sent from one part of the line to another as times of stress developed or were anticipated In a hospital of this type where I worked for several weeks during such a period, as head of an American operating team, there were twelve teams to each service of 1000 patients, or thirty-six in the entire hospital These teams worked in eight-hour shifts, night and day, during the height of the offensive The result of this organization was that all patients were operated upon without delay, and the best possible surgical results were obtained to the large evacuation hospitals, there were smaller mobile hospitals (Fig. 2) nearer the line, in which some of the graver non-transportable cases, eg, injuries of the head, abdomen and thorax, severe multiple injuries, were operated upon and kept until they could be more safely transported, and moribund cases were cared for until they died During this period, great advances were made in the methods of treatment and results, and the principles of early, thorough débridement, and primary and delayed primary suture, were developed with brilliant results No such results would have been possible had the operative work been done in hospitals not thoroughly equipped and manned for major surgical work. It was demonstrated that war-wound surgery demanded the highest degree of operative skill, that it is no work for a novice, and that results were successful in proportion to the ability and training of the surgeon

Unfortunately, the success of this system of highly organized hospitals depended on a relatively fixed fighting line, and the great German drives of March and May swept away many of these splendid hospitals

Our own service has adopted the plan of establishing evacuation hospitals near the line, and Evacuation No 1 and No 2, organized in the early spring, have been doing excellent work. Surgical teams headed by some of the best of our surgeons in France are in charge of the work and results have been most gratifying. Under the supervision of Colonel J. M. T. Finney (now Brigadier General), Chief Consultant, Surgical Service, A. E. F., and his staff of consultants, the professional work has been developed and standardized Ideas from the best methods of the French, British and Belgian services have been incorporated into our own procedure.

Additional mobile surgical teams with carefully selected operators, many of whom had had a period of observation and training in these hospitals, were being rapidly formed and sent to the front as new evacuation hospitals were established. Three mobile hospitals had been organized, others were being assembled, and from 75 to 100 will probably be in active operation before next summer. Our units are to be kept smaller and more mobile, for adaptation to the rapid changes in the line which have been the feature of the summer campaign of 1918

Seventeen splendid hospital trains (Fig. 3) were in operation for evacuation of the wounded to the base hospitals of the interior, and at least 50 will soon be in use. They are 16-car trains with a capacity of 360 stretcher cases, or up to 550 sitting patients

#### CHARLES H PECK

A line of thoroughly organized base hospitals (Figs 6-10) extends from northeastern France to the Brittany coast. These are established in buildings of three general types, i.e., military barracks, summer hotels and large schools or colleges. Additional bed space is usually obtained by newly built barracks of wood, brick or concrete, and the capacity of each unit varies from 1000 to 2500 beds. In addition to those already established, there were ten large base hospital centres under construction, each to have from 5000 to 30,000 beds, some nearly completed, all well under way. The number of base and evacuation hospitals in France has been greatly increased since midsummer.

Patients are moved from the evacuation hospital back to the base hospital by hospital train as soon as they can travel safely, slight and moderate wounds within a few hours or a day or two, severe cases being often kept from one to two weeks. It is estimated that from 70 per cent to 80 per cent of all casualties are able to return to duty within two months

Large convalescent camps or departments are being established in connection with all base hospital centres in the proportion of one bed to five, so that patients may be given graduated work, exercises or drill before returning to full duty. Thus a centre with 20,000 hospital beds will have accommodation for 5,000 convalescents. Base Hospital No 8 has a farm of 100 acres devoted to this purpose. Patients likely to require more than four months' treatment, for return to either full duty or some useful service in the rear, will generally be sent to the United States as soon as they can safely travel

The Medical Department of the American Expeditionary Force, with the cordial support of the Department in the United States, directed by the master minds of Surgeon General W C Gorgas and Chief Surgeon, A E F, General Merritt W Ireland, has accomplished a gigantic task during the past fifteen months and has established a system of hospitals manned by the ablest surgeons our country has produced, many of national and international reputation, which will guarantee the best possible surgical treatment to our wounded, who fall in the battle line in Fiance

The illustrations show examples of battalion aid posts, mobile, evacuation and base hospitals, and hospital trains, and some of the various types of housing and shelter in use

#### QUINO-FORMOL SOLUTION IN WAR SURGERY

A PRELIMINARY REPORT\*

#### By JAMES TAFT PILCHER, M D

OF BROOKLYN, NEW YORK

MAJOR M C, U B A 3

THE formulation of this solution was undertaken because the following observations had been noted in practical hospital work

- I That Dakin's solution was not stable
- 2 It was difficult to prepare and standardize properly
- 3 It frequently mintated, probably because of its improper preparation
- 4 The protection of the skin took time and material
- 5 The prescribed strict and rigid formula for its application has until now not been found feasible to effect any further forward than at a base. The severe infections of war wounds are usually firmly established before its application is begun
- 6 The slimy discharge, caused by serous exudate and cell detritus, by covering over the tissues, appeared to us to militate against the action of germicidal agents on bacteria present in the wound
- 7 This discharge effectually prevented the dressings from absorbing the wound secretions
- 8 The wound secretions in many instances appeared to become locked up, and toxic absorption therefore unquestionably increased

Feeling, however, that there was a mechanical, as well as a chemical problem to be met, the observations of Colonel Wright and Major Taylor were thoroughly reviewed and considered, that of the former to deplete the greatly swollen tissues and cause a positive flow of fluid into the wound, and that of the latter because of its seeming analgesic effect on the law surfaces, in addition to its bactericidal properties. An attempt was further made to enhance this germicidal action, and, in addition, to prevent the mass disintegration of partially devitalized tissues so commonly noted, and thus minimize the toxemia by preventing the production of this most suitable media

A solution to meet these difficulties seemed desirable, one that would be simple of preparation, stable, one that could be concentrated for transportation, the strength of which could be easily increased or diminished and one

<sup>\*</sup>Read before the Research Society of the American Red Cross in France, Paris, France, September 6, 1918

#### JAMES TAFT PILCHER

that could be used in an early stage of wound treatment, namely at the field or evacuation hospital

This was apparently accomplished by the following formula

Quinine sulphate	1 gm
Hydrochloric acid	50 c c
Glacial acetic acid (99 per cent)	5∞ cc
Sodium chloride	17 50 gm
Formol (40 per cent)	100 cc
Thymol	25 gm
Alcohol (90 per cent)	1500 CC
Aqua q s ad	ı lıter

(1) Dissolve the quinine in the hydrochloric and acetic acids (2) Dissolve the sodium chloride in the water (3) Dissolve the thymol in the alcohol Add No I and No 2, then the formol, and finally the thymol solution. The solution is best applied as directed for the use of the Carrel-Dakin solution, or may be injected through the Carrel tubes every two hours, or more frequently if necessary, to keep the wound bathed with it

The hydrochloric acid, as noted in the formula, is used to put the quinine in a more perfect solution, the acetic acid for its action with the quinine solution, giving a solvent and analgesic effect, the sodium chloride for its dehydrating properties, the formol for its bactericidal and fixing properties, as is the alcohol, which is used to get the thymol into solution

To test its efficacy it was employed on one hundred cases of severely infected wounds at the American Red Cross Military Hospital No 5, mostly compound comminuted fractures, which had been treated for ten days to two weeks or longer with Dakin's solution, and in which the bacterial flora showed no signs of diminution in the great majority of instances Bacterial counts and cultures demonstrated pure and mixed infections of the Welch bacillus, pneumococcus, streptococcus, Friedlander, staphylococcus, etc., in the following list of injuries

18
II
II
3
I
2
I
6
2
I
2
3
1
I
I
8

#### QUINO-FORMOL SOLUTION IN WAR SURGERY

Perforating G S W with foreign bodies	
Thigh	10
Leg	5
Abdomen	2
Chest	2
Arm	4
Neck	I
Amputation (G G)	
Leg	3
Arm	I
Total	100

The essential procedure previous to the application of any antiseptic solution is the institution of adequate surgical measures as pointed out by Dépage, an extensive débridement, esquilectomy and removal of fragments It is only as an adjuvant to the above that these chemico-mechanical solutions should be used, and unless thorough and painstaking surgery is accomplished, according to generally recognized principles, no one can possibly expect any results from the subsequent wound lavage with any solution. It might be argued, therefore, that those who have not met with marked success in the use of such treatments as those offered by Carrel-Dakin may not have appreciated the importance of this essential principle

With this in mind the following observations are offered for confirmation, hoping that we may, by development and suggestion, evolve for the early and immediate treatment of these wounds an adjuvant which, by virtue of its properties of stability, non-irritability, ease of preparation, simplicity of ingredients, and the feasibility of concentration, will lend itself to the emergencies ever present in the zone of the advance, more essential the further forward one is, and most necessary at the very place where its best work may be accomplished—at the field hospital, and where the refinements of the preparation of Dakin's solution and its proper administration are impossible

- (1) Quino-formol is actively inhibitive and destructive to aërobic and anaerobic bacteria and protozoa, and can be utilized in field hospitals
- (2) The degree of irritation caused by it is insignificant, even over long periods of time
  - (3) It is a stable solution, easy of preparation and mildly deodorant
- (4) It may be concentrated, or the normal strength solution may be increased in any of its constituents, without detriment to the other ingredients
- (5) There is a very definite flow of fluids from the tissues into the wounds, with consequent depletion and dehydration of the engorged areas, due to the hypertonicity of the solution and rapid relief of the neurovascular system, encroached upon by the swollen tissues, therefore tending to relieve the distal ischæmia and consequent impending gangrene, as well as the relief of local pain due to the great engorgement
  - (6) There is an apparent analgesic effect on the exposed surfaces and

#### JAMES TAFT PILCHER

the dressings are remarked to be less painful, certainly the gauze is more easily removed and is noted to be impregnated to a much greater degree by the wound secretions than was the case where other solutions had been employed

- (7) The formol, synergized by the alcohol content, is believed to render the tissues less susceptible of bacterial invasion, owing to their slight hardening and fixing properties, thus diminishing the formation of suitable culture media
- (8) The acetic acid, in conjunction with the increased flow of serum into the wound, apparently acts as a definite solvent and cleansing agent, causing the secretions to be entirely absorbed by the dressings, and therefore favors more direct action of the antiseptics on the tissue surface and on the germs free in the wound
- (9) The muscles appear to be more firm and of deeper color The wounds in many instances have been exceptionally dry
- (10) Epithelialization is apparently greatly stimulated, and is not of the anæmic type noticed with Wright's solution
- (11) The normal coagulation time of the blood is practically unchanged or but very slightly retarded
- (12) The solution has no proteolytic properties, and when "felting" or deposition of fibrin is noted, Dakin's solution has been administered until the wound is clear of detritus. This has been found to be a most important and essential adjunct in the ultimate treatment.
- (13) There has been a marked pronounced drop in temperature and pulse in many cases on changing from Dakin's to quino-formol, without any attendant operative procedure
- (14) Some wounds showing a count of 10 to 15 bacteria per field have been apparently rendered free from germs within three days. That is to say, none have been found in the repeated examination of 15 fields
- (15) Thirty consecutive cases treated within thirty-six to forty-eight hours after receipt of injury, on whom pre-operative smears were made and the presence of infection established, were rendered sterile within forty-eight hours and have continued to show absence of any bacteria on repeated counts subsequently, with one exception

The bacterial counts and their attendant preparation have been personally accomplished by Lieutenant Coward, and the experimental investigation has been carried on by Lieutenant Wells. The supervision of the preparation of "quino-formol" has been under the direction of Lieutenant Ernest Martlew, Pharmacist at A. R. C. M. H. No. 5

These observations are not entirely personal, but represent the experience of a number of surgeons at the American Red Cross Military Hospital No 5, and have been controlled in many instances by Major George de Tarnowsky, under whose direction this research has been made and through whose courtesy, in affording me material, the above notations have been made possible

# HISTORY ANALYSIS APPLIED TO SURGICAL DISEASES OF THE BILIARY TRACT AND PANCREAS \*

#### By ALLEN O WHIPPLE, M D

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ABSISTANT VISITING SURGEON, PRESENTERIAN HOSPITAL

(Under a grant from the Harriman Research Fund, College of Physicians and Surgeons, Columbia University, N Y)

In recent years scientific clinical research has emphasized the supreme importance of an accurate history in making a differential diagnosis of the lesions of the upper abdomen. By many eminent surgeons the history is placed above physical signs, laboratory and X-ray findings in the order of their importance in determining the lesions of the biliary tract, yet there is lacking in the record systems of the majority of our hospitals any accurate or comprehensive method of eliciting the data desired and of analyzing such data even when available. The efforts of able and honest surgeons to collect and correlate their data are constantly thwarted by a lack of a comprehensive and accurate record system, and the published writings of many investigators are based upon inaccurate and insufficient data for the same reason

It was the desire to obtain facts in the study of surgical diseases of the biliary tract that led the author to formulate the history analysis which is here reproduced. The faults in it are many, and many points of information may have been omitted. The analysis is being changed as new ideas are suggested. The point is that the cases in which the analysis has been carried out have afforded a basis for accurate deductions, as compared to the mere impressions that one gains from a study of the average hospital histories in a corresponding number of cases.

The term "history" is here used in its broadest sense. It includes the anamnesis, the physical examination, the laboratory and clinical findings, the discussion of the pre-operative diagnosis, the pathological reports, the notes on the post-operative course and complications, the discussion of the case by the operator and house surgeon, in case of death, the autopsy report and an analysis of the cause or causes of death, and, finally, but most important, the follow-up notes made at the time of subsequent visits or communications from the patient. Included in these follow-up notes there should be a statement, after each visit, of the result of the therapy based upon the anatomical, symptomatic and economic condition of the patient, 1e, a true interval result

But to have a uniform and inclusive analysis of the histories of a group of cases, it is essential that a comprehensive and detailed chart analysis be

<sup>\*</sup>Read before the New York Surgical Society, May 8, 1918

#### ALLEN O WHIPPLE

filled out while the patient is under observation. This chart should not take the place of the history, but should be filled out after the diagnosis is established and while the facts relating to the case are fresh in the mind of the observer or observers and obtainable from the patient and those connected with his case. It is a deplorable fact, realized by every surgeon who has tried to analyze a group of cases he was interested in, that only a small percentage of the desired information can be obtained from histories as they are taken by inexperienced internes in the average up-to-date and otherwise efficiently run hospital. It is also deplorable that not a little of the information contained in current literature of a clinical nature is based upon this inaccurate type of history analysis. Great credit is due to the staff of the Mayo Clinic for the practical and thorough work that they have done in establishing their history analysis system, notably in the diseases of the thyroid gland.

Certain features of a hospital record system are essential to the honesty and success of any history analysis and the conclusions based upon such an analysis. These should be discussed at this point

I There should be a complete and inclusive analysis chart, drafted by a member of the attending staff interested in and intensively studying the cases He should supervise and check up the work of the interne to be analyzed staff and should review all the charts, if possible, before the patient leaves the hospital Before deciding definitely to adopt an elaborate chart, for the analysis of cases over a certain period, it is wise to test out such a chart on fifty or more histories In this way experience will add to the value of the analysis chart and certain details which will be found impractical or unnecessarv will be eliminated Others will be found of more importance than was expected If the subject to be analyzed is a large one, or an inclusive one, such as surgical diseases of the biliary tract, it is of great advantage to have the histories of certain subdivisions, such as acute cholecystitis, common duct stone, carcinoma of the pancreas, grouped together on the unit sheets so that the summaries will cover definite groups of cases, at the same time these divisions will not affect the totals for the entire subject

It has been very instructive to the writer to note that in the carefully analyzed cases, certain long-favored and deep-rooted "impressions"—acquired from text books, collateral reading or emphatic statements of famous clinicians—were proved doubtful by the recorded facts. Thus the percentage of cases giving a history of typhoid fever or showing a bacillus typhosus in the culture of the bile from the gall-bladder proved to be much lower than that mentioned by many writers. On the other hand the involvement of the pancreas in gall-bladder disease, as noted at time of operation, was much more frequent.

2 Of mestimable value is the unit history system, in which all notes relating to the case, from the time of admission to any part of the hospital, out-patient or in-patient, including follow-up notes, until the patient is lost track of, are recorded in the same folder or cover—All notes made on sub-

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sequent admissions to medical or surgical services, to the out-patient department or to the follow-up clinic are added to the original history. It is in a true sense a continuous and continuing record of that individual. Only those who have tried history analysis with the old-time bound volumes, bulky and deplorably incomplete, and who have later used the unit history can appreciate the advantage of the data all collected in one cover or folder. These folders or bindings are easy to handle, the analysis charts are filled out and included in the history and all the follow-up notes are to be found at the end of each admission to the hospital

- 3 Equally important is a comprehensive and strictly supervised disease classification file, that makes it possible to record and to find easily all the cases under definite diagnoses, together with associated or accompanying conditions Without such a system many cases of a certain disease or lesion will be lost because of inaccurate filing, or because they may be filed under various diagnoses It is absolutely essential that all diagnoses in the histories conform to the terminology in use in the hospital New terms may be added to the terminology by consent of the record room committee Lambert has elaborated the terminology, worked out by himself and Dr Walton Martin in 1910, and has made it the key to the record system at the Presbyterian Hospital The disease classification file, which corresponds to or rather is a copy of the terminology, now includes not only the numbers of the case histories under the various diagnoses, but the interval results for these same diagnoses In this way, for example, one can in a few minutes determine the one-year or three-year results in common-duct stone cases by turning to the file under "Cholelithiasis, Stone in the Common Duct."
- 4 It is essential to have a thoroughly organized and active follow-up system Without a systematic and energetic follow-up of all cases there is always a tendency to report only the good results, for the failures go elsewhere for subsequent treatment. It is a noticeable fact that in hospitals having a thoroughly organized and efficient follow-up system, the percentage of poor results and of recurrences is much higher than in hospitals where reported results are based upon the "impressions" of the Attending or House Impressions are not facts Facts regarding the subsequent course of cholecystostomies, for example, as compared to cholecystectomies, cannot be obtained unless these two types of cases are followed up at regular intervals and are asked definite questions and examined from the anatomic, symptomatic and economic standpoints If the patients are seen at three- to sixmonth intervals they are not lost track of so easily, their interest in the follow-up is kept active and their cooperation is far greater than if sporadic efforts are made at long intervals to get in touch with them. In a metropolis like New York, few of the patients of the type we see on the ward services live at one address longer than six months
- 5 The natural result of a follow-up system is the result file, in which are recorded, under the same diagnoses as in the disease classification file, the results of the surgical treatment, at various intervals after operation These

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results are to be based upon the combined anatomical, symptomatic and economic condition of the patient at the time of each follow-up visit from these standpoints should be recorded in an ascending scale of excellence Failure is represented by o, and I up to 4 represents degree of success Thus a 000 would represent a failure anatomically, symptomatically and economically in a case of cholecystostomy where hernia after operation, with persistent symptoms of discomfort and indigestion, had resulted in the patient's inability to do any of his former work A 4 4 4; on the other hand, would represent complete success in a case where the scar was linear and firm, where all symptoms of the disease had been relieved, and where the patient was working at his maximum efficiency The results should be recorded in the file for the intervals under observation, and should be reported as 3-, 6-, 12-, 24-, or 36-month results, according to the interval, rather than "end results" This principle is of special importance in recording results in neoplasms. Such a system is of particular value in comparing the relative advantages of several surgical procedures for the same lesion over various periods, as for example the efficacy of cholecystectomy compared to cholecystostomy in pancreatic lymphangeitis, or in calculi in the gall-bladder or the relative advantages of the transverse and vertical incisions in gall-bladder operations

6 The follow-up notes and results should be recorded by the surgeon intensively studying that particular group of cases that have been recorded in the history analysis, that is, he should follow the cases of that group whether he operated on them or not. Only in this way will the notes and the results be uniformly recorded. The details of the record room system at the Presbyterian Hospital, including descriptions of and photographic reproductions of the various parts of the disease classification file, the unit history, the follow-up system and interval result file are to be found in the Annual Surgical Report of the hospital which is to appear in printed form in November, 1918

With these desiderata an accurate and comprehensive analysis of any group of surgical diseases can be had at the end of two to five years. With the data obtained from such an analysis, definite conclusions can be drawn as to diagnosis, treatment and prognosis and the true value of such a study will then be realized. Groups of cases, or systems thus intensively studied, give data not only for the individual surgeon to make use of in formulating his own ideas and reaching conclusions based upon fact, but provide cumulative material of increasing value as time goes on and as the facts are collected. A record system, as at present in active operation at the Presbyterian Hospital, increases its value from year to year, because material is accumulated, in available form, for subsequent analysis and there does not occur the deplorable waste of clinical experience so common in so many large hospitals. As an example of this benefit, I would mention the use to which the record system is being put by the Surgical Pathology Laboratory in collecting interval results for all the tumor and tuberculosis specimens that come to the

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laboratory The education of the medical students, to say nothing of the surgical staff of the hospital in this systematic, comparative study of the tumors coming to the hospital, is in itself worth all the effort and expense of maintaining such a record system

Constructive work in a hospital, as a result of prolonged and persistent effort, is frequently not appreciated until others, making use of the material available because of such constructive work, attract the attention of the profession and even of the laity to the value of an individual's accomplish-For ten years, Dr Adrian Lambert, now Surgical Director of the Presbyterian Hospital, has been developing, and encouraging his colleagues to develop, an accurate, comprehensive and educational hospital record sys-In the first few years there had to be overcome that mertia of hospital and staff tradition that has brought to a dead stop so many needed reforms As the advantages and improvements of the system became apparent, other members of the attending staff were encouraged to develop new phases. such as the follow-up system, the unit history and the result file Lambert belongs the credit for developing the present complete and growing record system at the Presbyterian Hospital

During the past two years, with the above-mentioned features available and actively cooperating in the record system of the Presbyterian Hospital. a history analysis of the surgical diseases of the biliary tract has been undertaken and is continuing. It is interesting to note that in the cases where the analysis chart was filled in at the time the patient was in the hospital oa per cent of the desired data was secured, whereas in the cases where the chart was filled out after the patient had left, from information available in the old history, and where the case was recorded without reference to the chart, only 22 per cent of the desired data was found

The analysis chart for surgical diseases of the biliary tract, as now in use in the study of some 400 cases, is presented herewith

#### HISTORY ANALYSIS FOR SURGICAL DISEASES OF THE BILIARY TRACT

Case No

History No

Patient's Name

Sex

Age

Admission date

Address

Discharge date

#### Operator

- CHIEF COMPLAINT
  - 1 Pain in 1)Epigastrium 2)RUQ 3)LUQ 4)RLQ 5)Rt shoulder 6)in back between shoulders 7)All over abdomen 8)at navel
  - 2 Soreness in 1, 2, 3, 4, 5, 6, 7, 8
  - 3 Vomiting
  - 4 Jaundice
  - 5 Clay colored stools
  - 6 Pruritus
  - 7 Biliary Fistula
  - 8 Symptoms of Indigestion
    - I Feeling of Distress in 1) Epigastrium 2) R U Q 3)LUQ 4)RLQ 5) Around navel

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- 2 Feeling of Distention in 1, 2, 3, 4, 5
- 3 Feeling of a Lump in 1, 2, 3, 4, 5
- 4 Belching of gas 5 Sour eructations
- o Constitutional Disturbances
  - 1 Fever 2 Chills 3 Loss of Weight 4 Loss of Strength 5 Loss of Appetite 6 Malaise 7 Constipation 8 Diarrhæa
- II HISTORY OF PRESENT DISORDER
  - I History of Present or Last Attack
    - I Onset
      - 1 Mode 1) Sudden 2) Gradual
      - 2 Time of Onset 1) Day 2) Night
        - 1) hrs 2) days 3) weeks 4) months ago
      - 3 Duration of Attack
- 1) hrs 2) days 3) weeks 4) months

- 2 Pain
  - 1 Type 1) Constant 2) Intermittent
  - 2 Character 1) Sharp 2) Dull 3) Colicky 4) Cramp-like 5) Stabbing or kmfe-like 6) Burning 7) Gnawing 8) Boring 9) Aching
  - 3 Location 1)Epigastrium 2)RUQ 3)LUQ 4)RLQ 5)About Navel 6)Rt Shoulder 7)In back between shoulders
  - 1 Localized to 1, 2, 3, 4, 5, 6, 7
  - 5 Radiation to 1, 2, 3, 4, 5, 6, 7
  - 6 Relation of onset of attack to meals hrs after ingestion of food
  - 7 Eased by
  - 8 Made worse by

(1) Vom ting 2) Defecation 3) Urination 4) Sitting up Lying down on 5) back 6) rt side 7) left side 8) pressure over epigastrium 9) over RUQ Medication by 10) mouth 11) hypodermic 12) hot application 13) cold application 14) belching gas Food 15) meats 16) starches 17) fats 18) acids 19) fried or greasy food

- 3 Soreness or Tenderness
  - 1 Onset 1)hrs 2)days 3)weeks ago
  - 2 Duration 1)hrs 2)days 3)weeks
  - 3 Location 1) Epigastrium 2) RUQ 3) LUQ 4) RLQ 5) around navel 6) Rt shoulder 7) back
  - 4 Worse on deep inspiration
- 4 Deranged Function
  - I Vomiting 2 Nausea
    - I Onset I) with pain 2) hrs after pain 3) hrs after ingestion of food 4) before onset of pain
    - 2 Number of times
    - 3 Vomitus
      - 1 Color 1) green 2) black 3) red 4) coffee-ground material
        - 2 Amount 1) slight 2) moderate 3) large
        - 3 Food 1) none 2) of last meal 3) of previous meals 4) mucus
        - 4 Taste 1)acid 2)bitter
    - 4 Jaundice
      - I Onset days after onset of acute symptoms
      - 2 Duration 1) days 2) weeks 3) months
      - 3 Pruritus
        - 1 Onset

days after onset of jaundice

2 Duration days

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4 Defecation

Movements have been 1)constipated 2)loose 3)normal 4)large 5)small 6)clay-colored 7)brown 8)black 9)contained gall stones 10)mucus 11)blood

- 5 Symptoms of Indigestion
  - 1 Feeling of Discomfort after meals in 1)epigastrium 2)
    RUQ 3)LUQ 4)RLO 5)about navel
  - 2 Feeling of Distention after meals in 1, 2, 3, 4, 5
  - 3 Feeling of a Lump after meals in 1, 2, 3, 4, 5
  - 4 Belching of Gas after meals 5) Sour Eructations
- 5 Constitutional Disturbances
  - I Loss of Weight lbs

In 1) days 2) weeks 3) months 4) years

- 2 Loss of Strength (If possible express in per cent of former strength)
- 3 Loss of Appetite
- 4 Chilis, No Daily 5 Has goose flesh been noticed?
- 6 Fever for days, weeks 7 Malaise
- 2 History of Previous Attacks
  - I Number of previous similar attacks Give the dates of the previous attacks accurately if possible
  - 2 Number of dissimilar attacks State in what symptoms these attacks differed from the present or last attack

In attack there was

In attack there was

In attack there was

- 3 Operation was performed months ago Name operation
- 4 Symptoms of Indigestion have been present for 1) weeks 2) months 3) years
  - 1 Feeling of Distress after meals in 1)epigastrium 2)RUQ 3)LUQ
    4)RLQ 5)about navel
  - 2 Feeling of Distention after meals in 1, 2, 3, 4, 5
  - 3 Feeling of Lump after meals in 1, 2, 3, 4, 5
  - 4 Belching of Gas after meals 5 Sour Eructations after meals
  - 5 Symptoms of Present Disorder began during or soon after the pregnancy

Symptoms of the attack began during or soon after the pregnancy Symptoms of the attack began during or soon after the pregnancy Did symptoms of present disorder begin 1) before the menopause 2) after the menopause?

Do symptoms of present disorder have any relation to menses? Do attacks come on before, during, or after the period?

- III HISTORY OF OTHER DISORDERS AND DISEASES
  - Name the diseases with the age of the patient at the time the disease was contracted and the duration of the disease if they were of the chronic type. This should include the venereal diseases. Be especially careful to ask for a history of typhoid fever and any previous peritoneal infection, such as appendicitis
- IV FACTS RELATING TO THE PATIENT'S NORMAL AND ABNORMAL HABITS, CUSTOMS AND ECONOMIC CONDITION AND ROUTINE
  - 1 Habits of
    - I Eating 1)regular 2)irregular 3)hearty 4)light 5)rapid 6)slow
       Diet Patient eats 1)coarse cereals 2)fruit 3)green vegetables 4)fried foods

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Meat is eaten a day Eggs are eaten a day Bread 1) white 2) whole wheat 3) graham 4) rye 5) bran Fish is eaten a week.

Cream a day Butter a day

Water is drunk glasses daily, coffee cups daily, tea cups daily

2 Defecation daily Bowels move regularly 1) with catharsis 2) without catharsis

Bowels move irregularly 1) with catharsis 2) without catharsis

Movements are 1) constipated 2) loose

- 3 Micturition during the night
- 4 Sleep 1) sound sleeper 2) light sleeper
- 5 Exercise 1) taken regularly 2) irregularly 3) none
- 6 Work 1)indoors 2)outdoors 3)manual 4)clerical 5)by day 6)by night 7)average working hours
- 7 Drugs
  - I Alcohol in the form of I)beer 2)ale 3)wine 4)whiskey or distilled liquors
    - 2 Number of drinks daily 3 Number of drinks before breakfast

Number of years that the patient has been taking alcohol

- 2 Tobacco is used in the form of 1) cigars 2) cigarettes 3) pipe 4) chewing tobacco
  - 1 Number of smokes daily, average 2 Number of years that tobacco has been used
- 3 Narcotic drugs are used in form of 1) Morphine 2) Opium 3) Cocaine
  4) Heroine
- 2 Economic Condition Monthly Income
- 3 Sexual History (for the female patients)

Menstrual History 1) regular 2) irregular 3) painless 4) painful

Marital History 1) Number of Children State their ages for relation to present disorder 2) Number of miscarriages State time of occurrence

- 4 Family History of gall-bladder disease in 1) mother 2) sisters 3) father
  4) brothers
- 5 Intelligence of the patient is 1) excellent 2) fair 3) poor
- 6 Accuracy of the history is 1)accurate 2) fair 3) inaccurate

#### V EXAMINATIONS

- I Physical Examination
  - 1 General Admission T P R
    1)acutely ill 2)chronically ill 3)well nourished 4)poorly nourished 5)obese
    6)thin 7)emaciated 8)cachectic 9)nervous 10)apathetic 11)skin jaundiced
    12)scleræ jaundiced 13)pale 14)cyanotic 15)dyspnæic 16)intelligent 17)
    unintelligent
  - 2 Head and Extremities

Tongue 1) moist 2) dry 3) coated Tonsils 1) enlarged 2) inflamed

Teeth 1) in good condition 2) carious 3) pyorrhœa present 4) false

Pupils 1) react normally 2) do not react normally

Extremities 1) knee jerks active 2) sluggish 3) absent

Superficial Lymph Glands 1) enlarged 2) not enlarged

- 3 Chest
  - I Heart 1)normal 2)enlarged 3)compensated 4)not compensated Blood Pressure, systolic
  - 2 Lungs Normal

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- I Signs of infiltration in I)RUL 2)RML 3)RLL 4)LUL 5)LLL
- 2 Signs of consolidation in I, 2, 3, 4, 5
- 3 Signs of fluid in 1 Rt chest 2 Left chest
- 2 Pelvic Examination

Adnexa 1) normal 2) inflamed

Uterus 1) normal 2) displaced 3) fibromyoma 4) carcinoma present

Rectal 1) normal 2) stricture or obstruction present 3) prostate enlarged 4) prostate inflamed

3 Abdominal Examination

Inspection 1) contour 2) obese 3) scaphoid 4) distended 5) biliary fistula 6) operations in quadrant, epigastrium, hypogastrium 7) hernia present in RUQ RLQ epigastrium, hypogastrium inguinal region, umbilical region

Palpation Tenderness present in 1)RUQ 2)over gall-bladder 3)epigastrium hypogastrium 4)RLQ 5)at navel 6)LUQ 7)general 8)rt costovertebral angle 9)over rt scapula 10)over border of trapezius, rt 1eft

Rigidity present in 1, 2, 3, 4, 5, 6, 7

Gall-bladder 1) palpable 2) movable from side to side

Mass made out in 1, 2, 3, 4, 5, 6

Liver edge palpable cm below costal margin Spleen palpable Rt kidney palpable

4 Radiographic Examination

Gall-stone shadow 1) present 2) not made out

Stomach 1) normal 2) defect at pylorus 3) defect in duodenum 4) adhesions present

Colon 1)normal Obstruction noted at 2)cecum 3)hepatic 4)splenic 5)sigmoid 6)rectum

5 Clinical Pathology

Blood Examination WBC Poly % RBC Hgb %

Blood Culture 1) sterile 2) positive for

Blood Cholesterin reading Blood Coagulation Time

Gastric Analysis 1) free HCl present 2) absent 3) lactic acid present 4) Boas-Oppler

Sputum Examination Pneumococcus Group I, II, III, IV Tbc present

Feces positive for 1)occult blood 2)bile 3)pancreatic ferments normal, diminished 4)ova, parasites 5)gall-stones 6)total fats

Urinalysis 1)albumen 2)casts 3)pus 4)sugar 5)RBC 6)bile 7)cystoscopy neg 8)acetone 9)diacetic acid

Wassermann Reaction 1) positive 2) negative Widal Reaction 1) positive 2) negative

Cammidge Test 1) positive 2) negative

#### VI Diagnosis Before Operation 1) based upon History 2) upon Examinations

1) Cholelithiasis 2) gall-stones in gall-bladder 3) in cystic duct 4) in common duct 5) Chr cholecystitis 6) Chr pancreatitis 7) Cholangitis 8) Chr appendicitis 9) Acute appendicitis 10) Acute cholecystitis 11) Gangrenous cholecystitis 12) Ac pancreatitis 13) Gastric ulcer 14) Duodenal ulcer 15) Perforated ulcer 16) Diffuse peritonitis 17) Acute ileus 18) Carcinoma of pancreas 19) Carcinoma of stomach 20) Biliary fistula 21) Mucus fistula

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#### VII OPERATION

- 1 Findings
  - Gall-bladder 1) Acutely inflamed 2) gangrenous 3) chronically inflamed 4) distended 5) collapsible 6) contracted 7) adhesions about gall-bladder 8) tumor in GB 9) adherent to common duct 10) not collapsible 11) normal 12) perforated 13) congenitally absent
  - Gail-stones found in 1)gail-bladder 2)cystic duct 3)common duct 4)at papilla of Vater 5)rt hepatic duct 6)left hepatic duct
  - Cystic duct 1)patent 2)thickened 3)dilated 4)adherent to gall-bladder 5)to common duct 6)closed
  - Common duct 1) patent 2) thickened 3) dilated 4) cystic 5) strictured 6) hepatic duct dilated 7) closed
  - Bile was 1) normal 2) thickened or inspissated 3) mucoid 4) purulent 5) granular Pancreas was 1) normal 2) enlarged 3) hard 4) acutely inflamed 5) chr inflamed 6) nodular
  - Liver was 1)normal 2)enlarged 3)cirrhotic 4)contained abscesses 5)perihepatitis 6)left lobe missing
  - Lymph Nodes were enlarged in 1)gastrohepatic omentum 2)about cystic duct 3)common duct
  - Tumor Mass was made out in 1)gall-bladder 2)pancreas 3)pylorus 4)liver 5)colon 6)stomach
  - Biliary fistula was found between skin and 1)gall-bladder 2)common duct 3) hepatic duct
  - Normal 1)gall-bladder 2)pancreas 3)stomach 4)duodenum 5)appendix 6)liver 7)colon 8)no pathological lesion found 9)rt kidney
  - ilcer found at 1)pylorus 2)duodenum 3)adhesions present about pylorus
  - Appendix was 1) normal 2) acutely inflamed 3) chr inflamed 4) cystic 5) tuberculous 6) carcinomatous
- 2 Procedure 1)cholecystectomy 2)cholecystostomy 3)cholecystotomy 4)choledochotomy 5)cholecochostomy 6)cholecystenterostomy 7)exploratory celiotomy 8)appendicectomy 9)gastroenterostomy 10)cholecyst gastrostomy 11)plastic repair of biliary ducts 12)transduodenal choledochotomy 13) common duct explored 14)ampulla of Vater dilated 15)gall-bladder sutured to parietal peritoneum
- Incision made was 1) vertical rt rectus 2) hockey stick 3) transverse 4) mid line vertical
- Drainage used was 1)rubber tube 2)catheter 3)cigarette 4)gauze 5)rubber tissue, into the 1)gall-bladder 2)common duct 3)hepatic duct 4)Morrison's pouch 5)to the pancreas
- Cystic duct was 1)clamped and tied with cystic vessels 2)tied separately 3)cauterized
- Anæsthesia used was 1)gas ether Bennett 2)drop ether 3)gas oxygen 4)gas oxygen ether 5)chloroform 6)local Novocaine 7)local Cocaine

#### VIII DIAGNOSIS AT OPERATION

1) Cholelithiasis 2) gall-stones in gall-bladder 3) in cystic duct 4) in common duct 5) chronic cholecystitis 6) chr pancreatitis 7) cholangitis 8) chr appendictis 9) acute appendicitis 10) acute cholecystitis 11) gangrenous cholecystitis 12) acute pancreatitis 13) gastric ulcer 14) duodenal ulcer 15) perforated ulcer 16) diffuse peritonitis 17) acute ileus carcinoma of 18) gall-bladder 19) pancreas 20) stomach 21) biliary fistula

#### ANALYSIS-SURGICAL DISEASES OF BILIARY TRACT

#### IX PATHOLOGICAL REPORT NO

Gross specimen consisted of 1)gall-bladder 2)gall-stones 3)bile 4)lymph glands, tissue from 5)gall-bladder 6)stomach 7)pancreas 8)liver 9)peritoneum 10)fistula 11)appendix

Gall-bladder Color 1) normal 2) green 3) red 4) black 5) mottled

Measurements were cm

Walls were 1)normal 2)moderately thickened 3)measured 4)very

Contained 1) bile 2) gall-stones 3) mucus 4) granular material 5) pus

Adhesions around gall-bladder were 1)fibrinous 2)fibrino-purulent 3)old Mucosa was 4)hypertrophied 5)atrophic 6)absent 7)necrotic

Gall-stones (state number)

1) single large cholesterin stone 2) facetted
3) mulberry 4) polygonal 5) combination stone present

Composition 1) pure cholesterin 2) cholesterin-calcium-bilirubin 3) bile pigment

Culture of gall-stone showed Analysis showed 1) bile salts 2) cholesterin 3) calcium

Culture of bile showed

Diagnosis 1)cholelithiasis 2)chr cholecystitis 3)acute cholecystitis 4)chr pancreatitis 5)acute appendicitis 6)chr appendicitis 7)Ca of GB 8)Ca of stomach 9)of lymph gland 10)gastric ulcer 11)duodenal ulcer 12)Ca of pancreas 13)biliary fistula 14)fat necrosis

### X HISTORY OF POSTOPERATIVE COURSE AND CONDITION

- 1 Postoperative Course
  - I First 24 hours 1) nausea 2) vomiting 3) headache 4) shock 5) hemorrhage
  - 2 Pulmonary 1)pneumonia 2)pleurisy 3)bronchitis 4)empyema 5)abscess lung 6)ædema of lungs
  - 3 Cardiovascular 1) fibrillation 2) cardiac decompensation
    - 3) Thrombosis of 1) femoral, rt lt 2) internal saphenous 3) external saphenous 4) mesenteric
    - 4) Embolism 1) pulmonary 2) cerebral
  - 4 Alimentary
    - 1)Distention 2)acute ileus 3)acute dilatation 4)colitis 5)acute cholangitis 6)Bile appeared in fæces on day
  - 5 Renal
    - 1) Acute suppression 2) acute retention 3) uremia 4) cystitis 5) pyelitis 6) pyelonephritis 7) acute nephritis 8) chronic nephritis
  - 6 Infection of 1)operative wound 2)abdominal wall 3)peritonitis 4)residual abscess of 5)subphrenic abscess
  - 7 Dressing 1)Sutures removed on day 2)drains removed from gall-bladder 3)drain removed from common duct day 4)drain removed from Morrison's pouch day 5)drain removed from abdominal wall 6)wound closed day 7)bile stopped flowing from wound day 8)biliary fistula closed day
  - 8 Patient discharged on day after operation
  - 9 Result on discharge 1) improved 2) unimproved 3) died on day
- 2 Advice and instructions as per pamphlet 1) were given 2) were not given
- 3 Follow-up notes (the date of examination or report to be recorded in Chronological Table with the numbers as indicating condition at time of report)
  - 1) Chief complaint cured 2) symptoms of indigestion cured 3) strength
    4) working capacity % 5) earning capacity % 6) weight
    Date of partially resuming work Date of resuming full work.

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- 7) Appetite 1) good 2) fair 3) poor
- 8) Bowels 1) regular with artificial measures 2) without artificial measures 3) irregular with artificial measures 4) without artificial measures 5) advice given in Ward before leaving the Hospital was followed 6) advice given in Ward before leaving the Hospital was not followed 7) constipated 8) loose
- 9) Examination
  - 1) Scar firm, no hernia 2) sinus present 3) bile discharging 4) no abdominal tenderness 5) no masses made out 6) masses felt in 7) jaundice present 8) hernia present in scar

XI FINAL RESULT months after operation 1) cured 2) improved 3) unimproved

XII AUTOPSY FINDINGS Details to be filed under each case if patient comes to autopsy

The master sheet is a copy of this chart, but so arranged that each fact to be recorded corresponds to a square of quadrilled paper, or if there are subdivisions to such a heading these are numbered and the number or numbers can be recorded in the appropriate square under the case that is being analyzed and recorded on the unit sheets. The information from the history analyses is tabulated on the large unit sheets and the information thus tabulated can be summarized in the left-hand margin of the unit sheets. The totals recorded in this way give the figures for each item in the series studied, thus it is possible at a glance to find the number of cholecystectomics performed in the series, or the number of cases in which a single cholesterin stone was found

By means of cross reference, *ie*, by noting the numbers of the case histories showing a particular feature, other desired data on that group can be obtained by referring to the appropriate squares in the master sheets under those history numbers. Thus one can readily find the late or the interval results in operated cases associated with lesions in the pancreas, or in cases showing single gall-stones, by analyzing the follow-up data. Once the information (the desired data) is recorded, the cross-reference possibilities come down largely to a matter of permutations and combinations

But it cannot be emphasized too strongly that the value and the validity of such determinations is dependent upon the accurate and honest recording of the facts while these facts are available from the patient or those having to do with his treatment. Thus a series of one hundred accurately recorded cases is of more scientific value than a thousand where incomplete data were obtained from the average hospital history.

From a study of the carefully analyzed cases in the Presbyterian Hospital series the following are some of the observations that stand out prominently

I Aside from the typical character and radiation of the pain in biliary colic the most constant symptoms of gall-bladder disease are those of "indigestion," ie, a feeling of epigastric distress, or a distended or "bloated" feeling in the epigastrium or left upper quadrant and the belching of gas. This group of symptoms occurred in 78 per cent of the cases

- 2 These symptoms are of much longer duration than is usually appreciated, especially in women. This places the onset of the cholecystitis or cholelithiasis in an earlier decade than is usually given, certainly in women the disease usually begins in the third or the fourth decade, during the active child-bearing period
- 3 Cholelithiasis was present five times more frequently in women than in men in this series. Eighty per cent of these women gave a history of one or more pregnancies. Thirty-two per cent, of the parous women gave the history that their first attacks of biliary colic occurred during the later months of pregnancy. The fact that many women gave the history of onset of symptoms during the menopause taken in conjunction with the facts relating to pregnancy emphasizes the importance of a hypercholesteremia as a causative factor in gall-stone disease.
- 4 Jaundice was not a prominent symptom or physical sign in this series—only 35 per cent giving the history of jaundice and only 20 per cent showing jaundice in skin or scleræ at the time of examination
- 5 Involvement of the pancreas, as observed at the time of operation in the form of an enlarged, indurated organ, or the so-called pancreatic lymphangitis of Arnsperger, a localized induration of the head of the pancreas about the common duct, was present in 36 per cent of the cases. This was found not only in the common duct stone cases, but in many cases in which the gall-bladder did not appear markedly diseased, but where the lymphglands draining the gall-bladder and ducts were enlarged and in many cases having the so-called "strawberry" gall-bladder with or without stones. Such cases gave much better results with cholecystectomy and choledochostomy than those treated by cholecystostomy. In the latter subjective symptoms of fat and proteid indigestion recurred or persisted much more frequently

In cases of chronic pancreatitis prolonged drainage of the common duct with cholecystectomy gave better results both from the standpoint of immediate operative risk and subsequent relief of symptoms than in the cases where attempts were made to dilate the strictured duct or maintain a passage into the duodenum by means of catheter drain

6 A hepatitis, either in the form of a localized or contiguous inflammation about the gall-bladder and ducts, or a general involvement, a true biliary cirrhosis was found on gross eaxmination of the liver in 21 per cent of the cases of cholecystitis. The lesion was found present on microscopical examination in all cases from which a section of the liver was removed. This coiroborates the observations of Evarts A. Graham, of Chicago. In two cases, the liver was enlarged, sections showed a marked cirrhosis, both biliary and portal, in one case ascites was present, and in both cases followed carefully after operation the liver decreased in size and the symptoms of

<sup>&</sup>lt;sup>1</sup>Evarts A Graham Hepatitis, a Constant Accompaniment of Cholecystitis Surgery, Gynecology and Obstetrics, vol xxvi, p 521

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cirrhosis disappeared following cholecystectomy and choledochostomy. In both these cases there was a marked associated pancreatic lymphangitis causing common duct obstructions

- 7 Postoperative pneumonitis proved to be the most frequent major complication
- 8 In the common duct obstruction cases hemorrhage during and following the operation proved the most serious complication. Jaundice was not necessarily present, for in two cases of long-standing biliary fistula the patients died of uncontrollable oozing from the wound

The one measure, used both as a preoperative and postoperative form of treatment in these cases, that proved to be unquestionably effective and, in several cases, life saving, was the intravenous infusion of a 0.2 per cent calcium lactate in normal salt solution. This was given in a 200-500 cc quantity. By coagulation time tests it lowered the clotting time by one-third to one-half in the eight cases in which it was tried. In the deeply jaundiced patients, where it was used four to six hours before operation, no persistent bleeding occurred, in the cases where it was given after oozing from the wound had become pronounced, the bleeding was invariably stopped. As a means of treating hemorrhage it proved very much more efficacious than the administration of bile, serum treatment or blood transfusion.

9 The comparison of the results following operations for gall-stone disease with those for gastric and duodenal ulcer and so-called chronic appendicitis is very much in favor of gall-bladder surgery. That is, comparing the interval results, 4,4,1e, a scar without hernia, entire relief of symptoms and a return of the patient to economic efficiency, in these diseases since the interval result system has been in operation at the Presbyterian Hospital, a period of two years, one finds "4,44" in 73 per cent of gall-stone disease, in 54 per cent in gastric ulcer, in 72 per cent in duodenal ulcer, and in 54 per cent in so-called chronic appendicitis

# A CONTRIBUTION TO THE STUDY OF MYOSITIS OSSIFICANS PROGRESSIVA

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With the first case of myositis ossificans progressiva described in medical literature over two hundred and twenty years ago, and for sixty years the course and pathology of this strange and raie malady well studied, its character and etiology are still unsettled and the subject of vivid controversy

The fact that another resemblant disease, the myositis ossificans circumscripta, produces identical pathological anatomical tissue changes in isolated muscles has not helped to clear up the mystery of its etiology and certain features in the symptom picture. The myositis ossificans progressiva is characterized by such a sharply outlined group of symptoms that it is marked as distinctly etiologically separate from its near namesake and not sharing anything with it in common save a relationship in local products of the pathological process

These characteristic features are

- I The ossification of muscles without any apparent cause, traumatic or otherwise
- 2 The manifestation of the disease as a congenital one or appearing early in life
- 3 The progressive course of the malady unaffected by therapeutical efforts, embracing in some of the most advanced cases nearly the entire voluntary muscular system
- 4 The association with symptoms of defective anatomical and physiological formation, mostly of fingers and toes but not infrequently also of stature, habitus and sex differentiation

These are the earmarks of typical cases of myositis ossificans progressiva, and, strange to say, there are very few exceptions, if any, of genuine cases of this malady which do not show them

It is true that since Helferich first drew attention to the presence of microdactylia in patients suffering from progressive ossifying myositis, quite a number of histories have been published that do not mention this symptom in cases undoubtedly belonging to this malady, but I have ascertained through personal correspondence with the authors of a number of such publications that the reason for this has been a lack of attention in examining for this symptom, mostly due to an oversight in the outdoor department and also in a few hospital cases

There are, however, a few cases where the authors have especially mentioned the absence of microdactylia, or similar anatomical defects, and these

are the observations which deserve special attention. Under the heading "remarks" of the collected case histories, the reader will remember this difference between microdactylia not mentioned and microdactylia noted as absent. The later definite statement should, in future, accompany all histories of such cases verified by the X-ray pictures of the hands and feet

I have taken the trouble in compiling in chronological sequence all the accessible cases of myositis ossificans progressiva. It seemed to me to be an effort well worth while to assemble in brief all the known data of this rare and mysterious disease, as my studies of its literature disclosed many errors and omissions in the two or three fractional prior attempts

The reason for undertaking this work was my own observation of a most interesting typical case, presenting among its symptoms the unique feature of several isolated and independent foci of ossification in the skin, a tissue hitherto believed to be exempt from this pathological change. It afforded unprecedented opportunity to observe and study the entire course of ossification from its first beginning to the completed bone-formation, a study which led me to advocate a change of view as to the primary factor of ossification in this disease

In the arrangement of this paper I shall first give abstracts of all cases of myositis ossificans progressiva published to date, then present my own case and finally discuss the views of the pathology and etiology in the light of knowledge obtained by the study of the existing literature and of the findings of my patient

#### ABSTRACTS OF CASES RECORDED IN LITERATURE

Case I—Reported by Guy Patin in 1692 Female Subsequent course of disease unknown Writes to A F (?) referring to a previous letter sent him, wherein he also mentioned the case of a woman who finally became as hard as wood all over

Case II—Reported by John Freke, in 1743 Male, aged 14 years First symptoms appeared at 11 years of age—swellings on back, muscles and vertebræ of back Began with swellings three years ago, then growths spread over entire back from cervical vertebræ to os sacrum, and arising also from every rib, forming coral-like ramifications Third year, from nape of neck to os sacrum and the lateral muscles of back, ossifications like coral branches, especially on back No congenital abnormalities mentioned

Case III—Reported by Rev Dean Copping and Robert, R R, Lord Bishop of Corke, and Charles Smith, in 1744 Skeleton of man, aged 60 years First symptoms appeared at (?) 18 years of age Subsequent course of disease unknown Entire skeleton one mass Could not open jaws, fed through gap in teeth Vertebræ consoldated by lateral outgrowths with scapula One bone, very thin, about four inches long, found in fleshy part of arm, quite distinct and disengaged from any other bone in his body Ridges and reefs of bone through fleshy parts of both thighs like shoots of coral, eight to nine inches long From back of calcaneum grow spurs of bone No congenital abnormalities mentioned

Case IV—Reported by William Henry, in 1759 Male, aged 19 years First symptoms appeared at 17 years of age—right arm, swellings and pains in wrist Both arms, ankles, and legs up to knees attacked Both arms from elbows to wrists just like a solid mass of bone, later pain, swellings and ossifications attacked ankles, creeping up fleshy part of calves to knees Was treated with mercurials to salivation (Observation covering two years)

Case V—Reported by Abernethy, in 1830 Male, aged 14 years First symptoms and age at their appearance unknown Various bony masses had formed at different times and disappeared again. Back greatly deformed by irregular hillocks of earthy matter over process; spinosi. Head immovably fixed backward and to one side Exostosis on both ossa brachii, and tendinous margins of axillæ ossified so that arms were pinioned closely to his sides. Exostosis on pelvis between os sacrum and, coccyx. No congenital abnormalities mentioned. Abernethy found urine contained less lime than normal. Two years later he gave patient phosphoric acid, 40 per diem in divided doses, with the result that normal quantities of phosphates of lime were excreted in the urine. When phosph acid was discontinued deficiency of lime occurred again.

CASE VI—Reported by David L Rogers, in 1833 Male, aged 13 years First symptoms appeared when at the age of 12 years and 6 months—stiffness in arms and neck Very rapid course, attacking muscles of back and chest Superior portion of pectoralis major and sternocleido from sternum to middle portion ossified A number of osseous swellings in back Scapula fixed to ribs, studded with bony excrescences, all muscles connected with scapula—viz, trapezius, rhomboideus, subscapularis—more or less ossified, latissimus and longissimus dorsi formed large bony plates from their origin to angle of scapula No congenital abnormalities mentioned

Case VII—Reported by Testelin, and Charles Dambesi, in 1839 Male, aged 26 years, mother suffered from rheumatism, patient fell on right thigh. First symptoms appeared at 18 years of age—pains and limping after trauma. Right thigh attacked Five years later pains in all extremities, movements began to be difficult, particularly scapulo-humeral articulation. Continued to move around seven years longer till he was unable to move either jaws, arms or legs. Became completely unable to move limbs or jaws. Twenty-one years later died, 39 years old. Autopsy showed ossification of right temporal and portion of left pterygoid, left deltoid, both pectorales major, left minor right coracobrachialis. Both biceps brachii, left triceps, right latissimus, right long dorsalis, right glutæus med and left med and minor, and most of thigh muscles on both sides.

Case VIII—Reported by Caesar Hawkins, in 1844 Male, aged 22 years First symptoms appeared at 22 years of age (June, 1843)—lumbar and dorsal regions attacked Violently painful swellings in lumbar and dorsal regions, which disappeared, leaving in places some small bony masses. Disease later attacks neck and scapular regions. New attacks began in October, 1843, and persisted during the next six months of observation. (One year after symptoms of disease.) Lumbar vertebræ immovably bound together by osseous masses, unable to use shoulders freely, particularly on left side, owing to swelling under angle of scapula and ossification of tendon of pectoralis major. Small exostosis on rib on either side (which rib?) No congenital abnormalities mentioned.

Case IX—Reported by G Wilkinson, in 1846 Female, aged 21 years First symptoms appeared at 8 months of age—stiffness in arms and lumps on back Could move about and work till 11 years old, then lost motion in elbow-joints, other ossifying processes progressed rapidly. Chest cavity much diminished by curvature of dorsal vertebræ and acute angularity of ribs. Numerous thin ossific plates in anterior and posterior chest muscles, as pectorales, first dorsa and erectorides spinæ, and one plate ten and a half inches long connected to crest of left ilium and short branches running from it into rhomboider to base of left scapula into infraspinatus, similar band from right crest of ilium to various vertebræ up to transverse process of third dorsal. Other irregular plates of bone connected spinal processes of dorsal and lumbar vertebræ and ribs connecting with sacrum by short tendinous fibres. Numerous bands of osseous matter in depressions of lower jaw, portion of bone two and one-half inches long in left biceps brachi. Two irregular bony processes, one from lower end of left humerus three inches downward into pronator teres and flexor muscles of

forearm, other from outer edge posteriorly extending into triceps and extensor carpinal longion et brevior. No congenital abnormalities mentioned

CASE X - Reported by King Kelburne, in 1854 Female First symptoms appeared at 3 weeks of age-defective power of suckling and swallowing Nourishment had to be brought into posterior part of mouth with spoon. Author discovered tumor on right side of tongue, size of large bean, judged to be of vascular nature, and therefore injected a few drops of perchloride of iron. In spite of a supposed improvement following this measure the child did not mend and died about five months later from manition Subsequent course of disease unknown mortem showed ankylosis (bony) between inferior maxilla and temporal bones, musc masseter replaced by a large osseous plate descending from the inferior margin of the zygomatic process and malar bone. The osseous deposit extended as far forward as the anterior process of the malar bone, incorporated itself in its downward passage with the tuberosity of the superior maxilla, and finally amalgamated with the angle base and ramus of the inferior maxilla. These changes were on both sides Vascular tumor on tongue had nearly entirely disappeared, leaving a fibrinous remnant of about the size of a split pea. No account given of other parts

Case XI—Reported by Jonathan Hutchinson, in 1860 and 1892 Male, aged 12 years First symptoms congenital Midwife noticed deformities, patient put in London Hospital on their account Subsequent course of disease unknown Left shoulder, wrist, and carpal joints ankylosed Left humerus shorter than right and bony ridge running down outer side Large plates of bony substance in fascia of forearm, palm and back of hand On right side small areas of bony structure in fascia above and below elbow-joint. No congenital abnormalities mentioned. At the age of 37 years the ossifications have largely increased in size and extent, and over right scapula and in posterior fold of right axilla new bony plates have developed Movement of thorax during respiration extremely limited

Case XII—Reported by William Skinner, in 1861 Male, aged 13 years Family history negative First symptoms appeared at 7, years of age—arms, back and right shoulder attacked Stiffenings in arms, swellings in nape of neck and behind right shoulder Stiffness at first was so bad that arms could not be brought to mouth This improved later so that he could with difficulty feed himself, but hard nodules formed on different parts of body, especially breast and vertebral column. If patient receives blow or knock a hard swelling follows, preceded by pain and slight fever Patient somewhat bent forward, slight motion in left shoulder, none in right. Arms cannot be extended and lie half bent across abdomen. Spine and scapula immovable Small bony protuberance on ribs. Right pectorales changed into bony mass—continued into biceps until insertion at radius. Hard nodules at various places. No congenital abnormalities mentioned.

Case XIII -Reported by Ivan Minklewitsch, in 1864 Female, aged 15 years Family history negative First symptoms appeared at 5 years of age—swelling and stiffness in lower part of neck. A few years later osseous tumors in back and upper extremities began to develop, then attacked lower extremities ago pain and swelling in right knee disappeared and a week later reappeared Exostoses in left temporal region at insert of temporal muscle, similar ones over left temporal and over acromion Muscles forming posterior wall of right axilla ossified Pectorales show same change, also small rough exostoses over cond int. humeri Left arm a similar ossification of axillary muscles Right lower extremities over articul tibia tarsalis stalactite-formed exostosis, similar one over fibula, another below lower margin of patella, in soleus muscle osseous growth size of hen's egg, in fossa poplitea narrow one extending upward to thigh and in stalactite formation reaching nearly Left lower extremities similar growth below patella plica glutealis and inguinalis as on right side, extending upward and inward to fossa poplitea and ending at upper end of middle third of thigh, sharp-pointed exostoses on outer side of astragalus and

outer malleolus No congenital abnormalities mentioned Report of autopsy, in 1871 New ossifications had formed at the right upper extremity on the upper posterior third of humerus and over inner part of that bone near elbow. The exostoses over cervical vertebræ and over second to fourth ribs were considerably enlarged

CASE XIV -Reported by Johanne Zollinger, in 1867, and Theodor Billroth, in 1869 Male, aged 24 years Believed to have been caused by fall (?) appeared at 3 years of age-arms first showed stiffness in movements ments of arms grew more and more difficult, and after a few years present state developed Bent forward in lumbar position of vertebral column Head bent forward. mouth can only be slightly opened for introduction of little finger Both sternocleidi muscles changed to rigid cords. Arms in slight abduction and flexion in elbowtoints, tendons of pectorales and deltoids hard and very tense. Back shows many protuberances of hard osseous consistency, situated mostly around the lower part of lumbar region, they branch off in many different directions. Especially large is a ridge going on either side into glutæus maximus, others in regions of sacrospinalis, irregular and asymmetrical Both latiss dorsi nearly entirely converted into bone First interphalangeal joint of left middle finger thickened by exostoses, and small roundish exostosis on left index finger Small exostosis at inner side of left tibia and on outer side of r cond ext femur No congenital abnormalities mentioned

CASE XV —Reported by Muenchmeyer, in 1868, and A Jurasz, in 1873 aged 22 years Family history negative Fall when 4 or 5 years of age symptoms appeared between 4 and 5 years of age-neck and right arm, nodules on nape of neck Development of right-sided scoliosis, stiffness of neck and right After first nodules on nape of neck had disappeared others came in different parts of body Brain fever at 12 years of age In May, 1864, had scarlatina does not recollect ever having been able to turn her head freely or move arms away from her sides Asserts never to have been able to dress herself or to do up her hair Cervical column and head completely immovable, position of head in right-sided Dorsal spine right-sided scoliotic and immovable, both scapulæ caput obstipum firmly fixed Left arm nearly completely immovable in elbow-joint, a nodulous osseous mass between cond ext hum and olecr, left biceps brachii one solid mass and long bony stalactite extending from middle toward axilla. Hard ossified parts also in Both latiss dorsi and trapezii, teres major and minor are changed to deltoid osseous masses Also the enormously thickened lig nuchæ No congenital abnormalities mentioned Latest observation in 1869, all changes have remained, and in addition the whole back one solid mass, protuberances, nodules and ridges, with some softer parts intermixed A six-centimeter broad osseous mass leading from vertebral column to scapula fixing the latter completely On the supraclavicular fossa everything except the omohyoideus seems to be ossified. In right leg whole gluteal mass ossified, from thigh down to knee several broad bony masses. During time of observation various places all over the body showed swellings, which disappeared again Immovability of jaws increased so that patient could take only liquid food 1869 disease got worse and continued from bad to worse In 1872 m gracilis involved In November mental trouble began February 26, 1873, she fell and broke her right arm Plaster-of-Paris dressing, cured in two weeks. No excessive callus Died in thirty-second year of her life Mays' autopsy report in 1874\* The autopsy report by Mays is too lengthy to be given here. It adds some exostoses to the ossifications found during lifetime, but shows the cerv muscles not to have been ossified, only hard and infiltrated with a connective tissue hyperplasia. No examination of fingers The spinal cord and periph nerves were examined by Doctor Schultzet and or toes found normal

Virchow's Arch f patholog Anat und Phys, bd 74, p 145

<sup>†</sup> Erb and Schultze, ein Fall v progress Muskelatrophie, etc Arch f Psychiatric und Nervkrkhtn, 1879, bd 60, h 2, pp 385-6

CASE XVI—Reported by Breschet, in 1869 Skeleton Subsequent course of disease unknown In addition to real exostoses, also multiple and symmetrical ossifications of muscular attachments Skeleton in Musee Dupuytren (Paris)

CASE XVII—Reported by William Byers, in 1870 Male, aged 17 years First symptoms appeared at 8 months of age—small tumors size of small marbles appearing in different parts of body. Various parts of body attacked. Stiffness of joints, hips and shoulder-joints. The first nodules disappeared, but after twelve to eighteen months stiffness of joints set in again. Gradual ankylosis followed, and at the age of 10 years left hip and shoulder joints were completely ankylosed. Later the muscular system began to show ossification. Chest became as though enclosed in a complete sheet of bone, leaving no trace of outline of ribs. Head was immovably fixed by ossification of both sternocleides. Up to his seventeenth year muscles of mastication remained unaffected. Could at first move slowly and cautiously over smooth surface, with ankylosis progressing this became impossible. No congenital abnormalities mentioned. Remained small, sexual infantilism. Died at the age of 21 years, muscular system almost completely ossified.

CASE XVIII - Reported by Florschuetz, in 1873, and Gerber, in 1875 aged 12 years Family history negative First symptoms appeared at 5 years of age-hard inflamed nodules in right latiss dorsi below right scapula. Latiss of left side, upper extremities and back attacked later. After having attacked shoulders and upper extremities it progressed to muscles of back, trunk, neck and mastication (tempor and masseter) and upper parts of lower extremities Frequent nocturnal epileptic attacks. Absolute stiffness of large muscular groups. The greater part of muscles of neck, all muscles of mastication, causing complete lockiaw (nutrition through gap in teeth), muscles of back, breast and arms (arms are immovably fixed to sides of body, only left forearm functions slightly), and finally those of left thigh and hip and part of right thigh are ossified Many muscles which are not ossified are atrophic, evidently in transitory stage, previous to ossification No congenital abnormalities mentioned Penis normal in size relative to age Scrotum atrophied and testes quite undeveloped Autopsy report, Mays,\* 1874 Very extensive autopsy in which several exostoses were found and most of the ossification diagnosed during life confirmed except in the cerv muscles, especially in sternocleidi mast and the delt and adjoining extensor muse of the arm, which only showed a firm infiltration, together with development of the connect tissue hyperplasia Fingers and toes not Spinal cord and periph nerves found normal by Schultze†

CASE XIX - Reported by Edward F Hamilton, in 1874 Female, aged 30 years (?) No clinical history obtainable Subsequent course of disease unknown Body brought to Medical School of St Stephen's Hospital Body inclined to left side, head bent forward, arms closely applied to sides, forearms flexed and pronated No motion of shoulder-joints nor of scapula upon trunk Left side of thorax contracted, right ilium nearly in contact with ribs Lower limbs flexed and adducted, right leg and foot much inverted, ankle joints stiff Skeleton showed Along anterior border of left masseter a ridge of bone preventing any movement of jaw Head immovably toined to upper cervical vertebræ Spinal column forms one solid mass, cervical, dorsal and lumbar vertebræ firmly joined by copious bone deposits, left shoulder-joint perfectly stiff and large plate of bone fixed to humerus near insert of pector mai reached up to coracoid proc, then down and inward till identified with costal cartilage Connecting the shaft of right femur and trochanter immense osseous growths resembling stalactites had formed, branched into the fibres of extensor muscles Similar growths were upon dorsum of ilium Osseous deposits at patellas, insert of quadriceps, extensor, tendon and many ligaments of soles of feet had ossified Between muscles of back from occipital bone to inferior angles of scapula and down to crest of

<sup>\*</sup> Op cit

<sup>†</sup>Op cit

ilium Consolidating hip-joints were enormous plates of ossific matter, in front of left femur osseous deposits bearing resemblance to a second femur. This deposit had been formed in cellular tissue between rectus femoris and cruræus.

CASE XX—Reported by Bennett, in 1874 Female, aged II years Family history negative First symptoms appeared in infancy—swellings over shoulder and back of neck Irregular attacks over various parts of body. On right side from protuberantia occipit to supraspinous fossa a bony growth is stretched, apparently situated in trapezius, irregular masses of bone are deposited in location of rhomboid muscles, and bony processes branch upward and inward from latis dorsi, portions covering scapular angles, other branches going down from those to crest of os ilium. Across middle and upper parts of loin transverse osseous bars have developed following the course and fibres of the muscle. A spur has commenced to grow from either ulna near attachment of pronator quadratus. No congenital abnormalities mentioned. Cast of girl demonstrated.

Case XXI—Reported by Dittmeyer and Gerber, in 1875 Female, aged 8 years Family history negative First symptoms appeared at 6 years of age—complained of pains in right side of nape of neck and shoulder. Stiffness of neck and right shoulder, some difficulty in breathing. Right shoulder grew immovable, breathing became more difficult. The left shoulder stood higher, head had been drawn toward left side. Right trapezius muscle stiff and hard, so that the head could not be moved to either side. The supraspinati and teres minor grew as hard as a board and arms were tightly drawn to sides of thorax. In serratus post, super one could feel the daily spread of the ossifications along the separate muscles. All other muscles were free. No congenital abnormalities mentioned. General health, with exception of the difficult respiration, was good, all organs functioned well. Autopsy report, Mays

Case XXII—Reported by V P Gibney, in 1875 Female, aged 10 years Family history negative Attack of diphtheria (?) First symptoms appeared at 10 years of age—had been perfectly well up to attack of diphtheria Subsequent course of disease unknown Muscles involved were latiss dorsi, scaleni and erector spinæ Right arm was held down by tendon of latiss dorsi. Also lateral curvature. No congenital abnormalities mentioned. No mention of microdactylia. At suggestion of a colleague acid lact was given, with no amelioration of symptoms, but there was no further progress during the next year and a half of observation. Seen again in 1893 Had been working in a millinery shop since 1884. No change of status. (Doubtful case.)

CASE XXIII—Reported by Huth, in 1876 Male, aged 4 years Family history negative First symptoms appeared at about 2 years of age—hard spots under chin Gradual extensions toward angles of lower jaw, then chest and other parts of body. Hard swelling size of egg developed over middle of sternum at about 2 years of age. It disappeared again. On shoulder and both upper arms swelling and hardness developed. In the spring of 1874 a swelling appeared on forehead, extending over eyelids, eyes being entirely closed. This disappeared again. Upper arms lying closely to trunk and fixed, lower arms movable. Head, neck and thorax muscles hard and stiff like armor. Both glutæi, especially of left thigh and leg, ossified. In abdominal muscles a cord thick as finger running from angle of ribs to os pubis. No congenital abnormalities recorded.

CASE XXIV—Reported by Nicoladoni, in 1878 Female, aged 7 years First symptoms appeared the first year of life—stiffness in muscles of neck Later stiffness in muscles of back. At present two hard ridges corresponding to sacrolumbales. The scapular muscles are ossified so that the shoulder-blades are immovably fixed to thorax. At upper part of biceps brachii are small bony plates in various parts of the muscle, its tendons changed to hard fibrous cords. The same changes present in sternocleidomastoider. The contracted right knee-joint can only

be extended to 120° Semitend and membranos changed to two hard lumps Pectorales also ossified and the axillary fossæ are bounded in front and posteriorly by rigid walls. The muscles of the lower jaw are also involved. No congenital abnormalities recorded

CASE XXV -Reported by H Helferich, in 1879 and 1883, Carl Mannz, in 1893. and Arthur Manneberg, in 1896 Male, aged 16 years Family history neg First symptoms appeared at 6 years of age-numerous hard nodules appeared upon head and gradually disappeared again Later similar painful nodules appeared on back. arms and back became stiff Between the twelfth and thirteenth years slow development of closure of jaws, first right molar had to be extracted to allow feeding When 15 years old could still push out tongue between teeth Jaws now firmly closed Arms gradually became stiff and nodules developed all over them Axillary fold hard, masseteric region hard ridges from the process zygomatic to lower jaws Jaws locked Neck in region of hyoid bone hard, but bone and laryny movable Thorax, pector maj shows ossified swellings Back, swellings of osseous hardness spreading like antlers from pelvis upward Right hip immovable, left hip normal, left gluteal region, flat resistant bone-hard mass, abscess developed in right inguinal region First case where attention was drawn to microdactylia of thumbs and big toes in this disease, although anatomical defect was erroneously thought to be defect of an entire phalanx instead of smallness of metacarpal or metatarsal bone. In later observation (1887) it is reported that case had remained fairly stationary since first observation In latest observation (1896) by Manneberg, quite an additional progress is noted, comprising old and new muscular groups

CASE XXVI—Reported by Partsch, in 1882 Male, aged 171/2 years history neg First symptoms appeared at 10 years of age-swelling after fall on right shoulder, disappeared again, but hardness remained in right side of neck. Developed stiffness of muscles, which affected right shoulder and upper arm, later left arm, after fall on and wounding forehead a swelling of os frontale followed Two years ago muscles of left side of neck hardened and drew head over to left side same time ossification of masticating muscles set in so that mouth can only be opened Head bent to left and fixed forward, both arms flexed in elbow-joints, right cannot be approached to body, left only with great evertion Both shoulders Cervical column rigid Sternocleido fibrous, but no bony enclosures Scaleni show osseous changes Right scapula carries a small roundish osseous tumor 4 cm long, 2 cm broad, lower border of left latiss dorsi entirely osseous Left brach ant contains osseous growth Right latiss dorsi shows osseous growths extending to upper arm and triceps. In back two osseous plates (II cm long), one in each fascia lumbodorsalis Exostoses 11/2 cm long near right spin ant os il Broad bony plate in right tens fas lat and narrower one in right sartorius Similar one 3 cm broad and 13 cm long in left sartorius Microdactylia of thumbs and big toes

Case XXVII—Reported by Herm Kuemmel, in 1883 Male, aged 13 years Family history neg First symptoms appeared fourteen days after birth (congenital)—foster-mother then observed striking deformity of spine and back and restricted mobility of both arms, which could only be slightly abducted from thora. In second year various fluctuating swellings were observed upon back. They shrank and hardened into exostoses. Except some hardening of more swellings no particular change occurred until twelfth year, when gradual contraction of left knee-joint began. Head inclined forward and slightly to right side, movements very restricted. Small exostosis on occiput. Arms hardly movable from sides of thorax, upper part of body bent forward and curved. Floor of oral cavity forms callous mass, including os hyoid, and thyroid cartilage. Both sternocleids and sternohyoid fibrous. Entire cervical spine bent forward and forms one continuous solid mass. Ligam nuche much thickened. Costal cartilage forms pectus carinat. In both

pectorales major, bony bars extending in right to coracobrachialis. Both axillary posterior walls contain bony bars. In right rect abdomin tough fibrous and thin bony band. Both pasas tough callous masses. Dorsal scoliosis to right, lumbar to left. From seventh dorsal vertebra downward processi spinos form one solid osseous mass. Both large trochanters broadened and prominent. Muscles of left thigh posteriorly changed into tough callous mass, with freely movable bony protuberance. Left leg flexed, angle of 45 degrees. Both thumbs nearly (?) normal, show bony ankylosis in interphalangeal joints. Microdactylia of both big toes ascribed to absence of first phalanx. (Real cause is probably smallness of metatarsal bone.)

CASE XXVIII—Reported by Uhde and Pinter, in 1883 Male, aged 16 years Family history neg First symptoms appeared first year of life—swellings on head, which disappeared after some time Patient broke arm in 1876 Fracture healed perfectly and shows hardly any trace of callus Head and shoulder joints bent forward, arms ankylotic in shoulder joints, movements in elbow joints limited only Ankylosis of interphalangeal joints in both thumbs Microdactylia of both great toes (with same probable error as above)

CASE XXIX—Reported by Krause and Pinter, in 1883 Female, aged 11 First symptoms appeared soon after birth—swellings Family history neg in several places on scalp, which disappeared again after several months. At age of 4 years swelling in some of the deeper muscles of that region. It spread rapidly, then decreased, but left board-like hardness, fixing scapula firmly to thorax time after same process occurred on right side Disease progressed to left latiss dorsi and biceps brachii, part of intercostals and serratus Two years ago right mylohyoid. geniohyoid and part of biventer followed with swellings, which, disappearing, always left board-like hardness with spinous growths 1 38 cm tall, circumference at mammilla 62 cm Slight kyphosis, convexity at seventh dorsal Left shoulder completely stiffened Deltoid atrophic Biceps ossified, fixing elbow in slight flexion spine to angle of scapula, two larger on right Over scapula and thorax flat exostoses Left latiss dorsi totally ossified Ribs below fourth rigid and unyielding No mention of microdactylia

CASE XXX—Reported by Gyula Pinter, in 1884 Female, aged 20 years First symptoms appeared at 4 years of age-hard nodules on back and disturbances of mobility of both shoulder joints Patient does not remember ever having been able to lift arms above shoulders At 6 years abduction of arms became so restricted that she could not write when seated at school desk joints remained free until twelfth year. About the twelfth year, during formation and healing of suppurating swelling over right tibia, nearly all her joints lost greater part of mobility In 1881 another suppurating swelling appeared on left leg, with a similar injurious effect on the various joints, rendering them still more rigid. When lying in bed rigidity of body like that in tetanus Head, caput obstipum nearly immovable, chin held out and downward, ankylosis of lower jaw-bone, only lateral excursion of about 2 mm in horizontal plane possible. Both temporales and masseters of bony Thorax absolutely immovable during respiration, owing to complete ossification of both pectorales major and minor Axillary fossæ rigid walls, both cucul-A bony ridge 2 cm broad, extending in middle line of back from prominentia occipit to seventh cerv vert Back and arms, two bony ones on either side of minth and tenth dorsal vert Left 10 cm long, 21/2 cm wide, sends branches toward left scapular angle and down to crista ilei Right, 6 cm long and 2 cm wide. sends similar branches anastomosing with other side. All firmly united with underlying parts of skeleton Shoulder-blades immovably fixed to trunk bone in ant and post muscles of both upper arms, and in left pronator teres and radial Pelvis and legs, exostoses 3 cm long on both crist near ant sup spine. Hip joints immovable, muscles origins from both tuber and ram asc. ischii and trochant.

maj all ossified Bony ridges in lower halves of bic fem and semitend and membr, muscles of lower legs and feet free Microdactylia of both big toes

CASE XXXI —Reported by O Kohts, in 1884 Male, aged 23 years tory neg First symptoms congenital Could not move since his ninth year, having then made his first attempt to walk. Severe pains ensued after he first tried to walk. which made him take to his bed until his fourteenth year, when he entered the hos-Patient 141 cm tall In bed could not change his position Head and trunk slightly bent forward and to right Lower jaws ankylosed Masseter and pterygoider apparently ossified Exostosis 2 cm long on inframaxillary bone Ligam nuchæ and No thoracic respir movement muscles cucullar and splen partly ossified Shoulder joints ankylosed Both may and minor clavicles show large exostoses pectorales contain bony plates, entire lower margins ossified Both arms firmly fixed Both coracoid muscles and left brach int ossified Right elbow-joint ankylotic At fourth rib exostosis 2 cm long Left elbow limited mobility coming from right condyl int humeri ossified in upper parts. Both hip-joints ankylotic Deep glutær and insert of right quadrat ossified Left tens fasciæ and tendon of right biceps femur and insertion of right gastrochemius contain bony plates Spinal column scoliotic, yertebr column ankylotic, muscles along both sides atrophic and ossified No mention of microdactylia

CASE XXXII - Reported by T Sympson, in 1886, and Stonham, in 1892 Male, Father rheumatic and presents same congenital deformity of toes as Fell on shoulder when 5 years old First symptoms appeared at 5 years of age-painful swelling formed on right shoulder after fall one week earlier, then shrank gradually, three months later a similar swelling appeared on left scapula Various swellings formed and disappeared again on back and chest Jan 16 (at demonstration) saddle of bone over loins, making stooping impossible each latiss dorsi, of each teres major and long head of r triceps were occupied by a series of lumps apparently bony, similar lumps present a little below occiput in left trapezius, the middle of neck and on right side, and on supraspinous fossæ Six years later (1892) two bones size of filberts found on inner side of post sup spine of r ilium Patient fell Aug, 1887, and broke both bones of left forearm Fracture united well A firm hard swelling involving left vastus ext and int, extending from just above patella upward for about four inches, consequent to a fall upon the knee A similar swelling posteriorly in the popliteal space, biceps and semitendin Motion of knee limited. A nodule size of filbert in middle of inner side of left thigh, situated in sartorius muscle Feet show head of each metatarsal bone large and prominent, big toe on either side small and apparently consists of only one phalanx (?) and is directed toward outer border of foot X-ray)

CASE XXXIII -Reported by Willett, in 1886, and Stonham, in 1892 Male, aged Family history neg First symptoms appeared at 6 months of ageswelling at superior angle of right scapula When I year old swelling along vertebral border and inferior angle of right scapula Six months later prominence noted in left erector spinæ and a little later a swelling near lower angle of left scapula frontal eminence enlarged Hard growth over left transverse processes of fourth and Right lateral dorsal curvature of spine, with slight comfifth cervical vertebræ pensat. curvature in lumbar region to left Slight kyphosis of upper dorsal spine Both scapulæ fixed Hard growth along vertebral border of right scapula dorsi at scapular angle and in its tendinous portion ossified. A similar, less extensive hardness on left scapula and latiss dorsi. A bony nodule on front angle of eighth rib, similar on left Both erectores spinæ ossified. On right knee just above head of fibula hard mass I inch in diameter, with nodule size of pea. Inner tuberosity of right tibia slightly thickened Both big toes hallux valgus position, displaced outward and under second toe Shortened microdactylia, only ungual phalana present

on each side (?) In Stonham's subsequent report six years later no correction of this statement of a very unusual condition is made

CASE XXXIV -Reported by Rickman J Godlee, in 1886 Male, aged three years Family history neg First symptoms were noted when I year old, but may have been present long before, as nothing was learned of previous history from parentsbony plates in right latiss dorsi and a nodule near right knee. Was not seen again till two years later, when present status was noted. In r latiss dorsi along outer border and post fold of axilla, irregular bony mass, arm cannot be abducted more than sixty degrees, but can be completely adducted Flexion of shoulders considerably limited, extension less, rotation inward more than outward On left side post a large elastic mass extending medially to nearly within the middle line and considerably below scapula, and upwards over shoulder to near clavicle. Scapula appears fixed in mass below angle This mass had disappeared on March 23, 1886, but there is a hard mobile mass below left angle Similar hard bodies, apparently bony, not movable, on free edge of left latiss Seen again May 20, 1886, over the fourth rib, behind in post axillary, ossifications Over third rib in posterior axillary line, similar ossifications Shoulder cannot be raised to right angle Head drawn down to left shoulder hard masses in muscles on outer side of neck (trapez and right mast excepted) arm cannot be raised higher than 45 degrees from trunk, scapula firm axillary fold hard nodulous mass. From angle of scapula a hard crest runs over to first lumbar vert Back strongly curved, lower left ribs down on crest of ilium valgus and microdactylia of thumbs Hallux valgus and microdactylia of toes

Case XXXV—Reported by R v Volkmann, in 1887 Male, age (?) Skeleton Subsequent course of disease unknown Various parts of his muscular system had been partially substituted by bony masses, which had grown into them V Volkmann had made attempts by removing some of them to restore a certain movability of ankylotic and immovable parts of the skeleton. The only published mention of this patient is made in a brief and vague reference in a discussion of Helferich's' case. The extirpated bony masses showed at one end an epiphysial layer of hyaline cartilage.

CASE XXXVI—Reported by Alfred Austin London, in 1887 Male, aged 431/2 Family history neg Accuses slight blows when 10 years old First symptoms appeared at 10 years of age—joints of legs and shoulders stiffened Gradually until his thirtieth year grew quite stiff and helpless. Jaws could only be opened very little Over sacrum a bedsore formed from which pieces of bone were constantly exfoliating Ossification of deltoid from acromial origin to insertion, also part of coracobrachialis Scapulæ immovable on trunk, their inferior angles soldered by dorsal buttress of bone attached by seventh to ninth ribs Latiss dorsi ossified nearly entire lengths Ossification of left brachialis anticus, and bony rims around both elbow-joints Sacro-iliac ligament ossified Both hip-joints ossified Bone rods developed in lower part of glut max and extending from sacrum to femoral insertion projection on back of femur. Dorsal lumbar curve, with slight rotation to right Very rigid, due to ossification of the capsular ligaments of the articular processes and many of the supraspinous ligaments Died at age of 46 Microdactylia of both big (No mention of thumbs) General synostosis of the neural arches ribs except the eleventh and twelfth are ankylosed to vertebral column undergone eccentric atrophy and are consequently rather light

Case XXXVII (?)—Reported by E. Schwarz and Cl Eichhorst, in 1888 Male, aged 40 years Family history neg First symptoms appeared at 39 years of age—a hard mass in posterior muscles of thigh Subsequent course of disease unknown Exostoses also on right humerus and on right femur in the region of the trochanter minor Hyperostosis of right fibula Suffers from tabes dorsalis. This case, as well as another from Eichhorst's clinic, both affected with spinal diseases. Do not belong to myositis ossificans progressiva. No microdactylia

CAST XXXVIII -Reported by Kronecker, in 1889 Male, age (?) First symptoms

appeared in (?) later years—first pains in nape of neck and in chest, two years previously. In November of the previous year the scaleni became affected. Since one year dyspnæa increasing, the cucullares are involved and the process is evidently progressing. Patient has pains in neck and one feels distinctly the increasing ossification. No microdactylia. (Doubtful, atypical case.)

Case XXXIX—Reported by J v Bokai, in 1899 Male, aged 5 years Family history negative Rickets First symptoms appeared at 4½ years of age—nape of neck and back Subsequent course of disease unknown Muscles of nape of neck, back and serrat anticus maj, pectorales maj, cucullaris and latiss dorsi are affected No congenital abnormalities recorded

Case XL—Reported by Ivar Svensson (Sabbatsberg Hospital), in 1891 Male, aged 14 years Family history neg Fell when 4 years old (?) Age of first symptoms unknown—stiffness of body, arms and back Stiffness has been gradually increasing Stiffness of head and back and arms Scoliosis on nape of neck, these are hardened and flattened and atrophied about the level of the levator anguli scapulæ, with fixed shoulder-blades, arms cannot be raised more than one-fifth of right angle from thorax Otherwise arms can be lifted to horizontal plane, but not higher Passive efforts to overstep this give crepitation and pain. In the height of axillary fossa a flat piece of bone of about 7 cm length and 2 cm width intimately connected with the tendons of latiss dorsi and teres major and to the edge of the scapula. At the inner sides of both scapulæ parallel with spine one can palpate a round bony formation of 5 cm length and hardly 1 cm width. No mention of microdactylia in either fingers or toes.

CASE XLI—Reported by C Studsgaard, in 1801 Female, aged 4 years Measles and whooping cough when 2 years of age First symptoms appeared at 2 years of age—noticed swelling after measles and whooping cough (Where?) First swelling (where?) disappeared again during use of cod-liver oil Growth of bony consistency appeared after another year without any cause on the left side of the neck, rendering movements of the neck, especially downward, very difficult Diffuse osseous swelling appeared on left lower jaw like convex continuation, cylindriform, size of finger, from base of that bone in region of premolar to incisura semilunaris sterm, and firmly attached to left horn of the corpus ossi hyoider with one end, with the lower movably connected with sternum Slight movements of maxilla are still possible, also small side motions of the head. The mass is situated anatomically as if it were as ossification of the sternohyoid muscle, wherefrom the bony part continues to the lower jaw Bone of neck extirpated February 4, 1891 Dismissed March 20, 1891 New bone formation on location of extirpated bone from neck Microdactylia of both thumbs and large toes and ankyloses of their phalanges

CASE XLII—Reported by R Gordon McDonald, in 1891 Female, aged 4 years Family history negative First symptoms appeared at 2 years of age-lumps appeared on left side of neck about middle of sternocleido. Later on lumps appeared All lumps disappeared after some time on forehead and back (dorsal vertebræ) Head fixed, unable to move it, sternomastoid, trapezius, stylohyoid, omohyoid and sternohyoid ossified. Over left frontal eminence a large node, smaller one over left temporal bone and right border of occipital Both elbows can be moved only eight inches from trunk, teres major, latiss dorsi, edge of pectorales major becoming gradually ossified Scapulæ fixed to ribs, right less than left At inferior angle of both scapulæ large nodes, on left superior angle a similar one, right side free Varioussized nodes along the vertebral spinæ from head to sacrum, also along lateral parts of several ribs and over crest of ilium. The superficial muscles of back are gradually ossifying Ribs are also becoming fixed and she is unable to take deep inspiration Teres major was, experimentis causa, exsected during hospital stay ossified Result as to mobility-none No congenital deformity mentioned

CASE XLIII - Reported by Bilton Pollard, in 1892 Male, aged 9 years Family

First symptoms appeared 6 months of age—lumps formed on lower angle of right scapula and nodules appeared on boy's ribs In second year neck was getting stiff In third year lumps formed between right iliac crest and the last rib In his fourth year hard nodule formed a little below patella after fall on right knee New lumps formed, his left arm stiffened and bony bands appeared in his neck up to his seventh year, but none during his seventh, eighth and ninth years. Neck quite stiff, rotation and raising of head barely possible Bony band between chin and sternum extending from the lower border and from the right of lower jaw to right side of cricoid cartilage, there dividing into two, the right ending just above sternoclavicul articulation, left above clavicle between the two heads of left sternocleido R arm can be raised to angle of 45 degrees only together with scapula Scar there from bony operation five years ago folds contracted plate slightly movable, apparently in latiss dorsi Pectorales and deltoid hardened, haid mass on border of radii two inches above styloid process. L arm equally stiff In course of teres major runs thick band of bone, extending free from inferior scapula angle almost to humerus Bony projection at left-elbow bend connected with biceps tend, another mass a little deeper down involving brach antic rigid, and on both its sides bony nodules and plates in dorsal and lumbar regions On outer and post part of r thigh flat osseous plate, smaller plate on left each thigh strong bony spiculæ, extending from adductors tubers upward to tend of adduct magnus for about two inches Irregular-shaped movable plate between lower fold of left condyle of femur and patella and a smaller one near outer tuberosity of Inner borders of both tibiæ show bony growths just below tuberosities congenital abnormalities mentioned Pieces of bone were exsected to improve mobility of arm and neck, but they soon formed again, and the slight improvement gained by the operation was lost

Case XLIV —Reported by Luigi Bernacchi, in 1892 Male, aged 7 years Family First symptoms appeared at 3 years of age—muscles stiffened in nape of neck without inflammatory symptoms Small hard tumors formed in right cucullaris over tuberosities of frontal and parietal bones About a year ago stiffness of humeroscapular joint appeared Left arm could not be raised above horizontal line hard osseous growths have formed along the spinous processes of dorsal vertebræ, and growths in lumbar muscle so as to form line from neck to os sacrum cervical projections over frontal tubera Head slightly inclined forward and to the left, movements restricted Neck and back, from the occipital insertion of right trapezius near middle, irregularly formed osseous tumors forming one solid mass of Thorax and abdomen normal, small exostoses above styloid process of Posterior wall of axilla shows fibrous consistency and is shorter than normal The scapulæ are united by bony ridge about their middle, an osseous tumor within the dorsalis major can be felt, size of thumb and somewhat movable. No mention of microdactylia (Photograph of boy shows indication of microdactylia of thumbs) No mention made in text

Case XLV—Reported by Ludwig Rabek, in 1892 Female, aged 3½ years Family history neg. First symptoms appeared at 6 months of age—hard nodules in region of shoulder-blades. Parents noticed movements of upper extremities were restricted, movements of lower jaw have been impeded since one year before. Difficulty and restriction of movements of lower jaw and both upper extremities. The distance ad maximum between the front rows of teeth is only 0.5 cm. Right masseter hardened and hypertrophied. The arms cannot be raised to horizontal line. Right elbow-joint contracted, extension incomplete, flexion normal. Shoulder-blades only slightly movable. Osseous tumors arise on many parts of the body, mostly on back. Large one in right axilla extends to latiss dorsi as far as scapula line of tenth rib. Another on left side reaches eighth rib. There are four more in the scapula and one in lumbar region, all in the muscles. Right biceps changed into hard movable.

mass united with shoulder muscles Small pea-sized nodules in right pectoral Big toes of both feet contracted outward and downward so that each lies under the second toe (Microdactylia and hallux valgus) Congenital deformity

Case XLVI—Reported by J Brennsohn, in 1892 Male, aged 20 years Family history neg First symptoms appeared in early childhood—a certain clumsiness of motion and elevation of right shoulder. Later a scoliosis, and three years ago right arm grew stiff, then left arm, then the trunk and subsequently the legs. Had to give up work in factory. The muscles of the posterior cervical region are completely ossified, all the anterior muscles feel rigid, especially the scaleni and right sternocleido, below the right lower jaw the mylohyoid forms a bony growth like a stalactite Mobility of head nominal, shoulders quite stiff, arms cannot be abducted from side of thorax. Left elbow-joint ankylotic, right only partly movable. Both anterior and poster walls of axillæ ossified, also deltoids, serrati antici maj and intercostales. The lower parts of left biceps and brachialis indurated and tense. Hand- and fingerjoints free. Ramified osseous growths from both cristæ ossis ilii into both glutæi max. Some mushroom-like exostoses from left crista ossis ilii. Both big toes microdactylic (metatarsus primus?) and in valgus position. Brennsohn ascribes it to missing of basal phalan. No X-ray taken

CASE XLVII - Reported by V P Gibney, in 1893 Male, aged 10 years Family history neg First symptoms appeared at 5 years of age-was admitted to the hospital at this time to sever a strip of ossified muscle, but was removed by parents Subsequent course of disease unknown Head tilted to right, upper extremities bowed so that thumbs touch elbows of opposite side, elbows abducted from trunk, shoulders stiff, right clavicle has extra curve at outer half, greatest convexity posteriorly Left clavicle curved entire extent, convexity toward neck From its middle springs irregular bony mass elevated half an inch. Base of this mass spreads in clavicular portion of pectoral major and continues in its pectoral part, terminating in anterior wall of axillary space. Over sternal articulation of second rib small exostoses tapering off into pectorales mass. Similar ones over sternal end of third and fifth ribs. None on right, about middle of fifth rib, just in front of axilla, a bony enlargement extending back and downward, involving the whole area of latiss dorsi and serratus magnus March, 1893, the bony tendon of the right latiss dorsi was divided and a piece of bone about one inch wide was excised, but new bone was thrown out and rendered void the effect of the operation. An osseous tumor the size of a peanut over tendo achillis which was removed did not return mention of microdactylia Private advice kindly given me says that author failed to take notes about presence or absence of microdactylia

CASE XLVIII - Reported by R Virchow, in 1894, and Bollinger, Linsmeyer, Kraske, Wollenberg, A Weil, Nissim and Weil, Faulkner, Lyon, De la Camp, Ponfick, Birch-Hirschfeld Male, aged 29 years Family history neg First symptoms appeared at 18 years of age—swelling and pain in maxillary articulation Pain, swelling and final ankylosis of maxillary and various joints of extremities. Osseous masses on both sides of median line of neck Bony elongation from right process coracoideus extending along tendon of that muscle and of the short head of the biceps for about 5 cm., somewhat less on the left side Ankylosis of right shoulder-joint tion of right triceps extending upward to teres and dorsalis muscles, also some ossifi-Small cartilaginous nodules on the tendons of abductor longus and extensor brevis pollicis The left arm shows the same changes as the right and a cartilaginous, fork-like formation over elbow-joint Irregular osseous masses in upper part of trapezius and over lumbar region projecting at various angles and of varying sizes Bony formations project from the sacro-iliac articulation to the right and left sides, reappearing in the iliac fossæ and extending to the coxofemoral joints, which they immobilize, reaching to the great trochanter and into the muscular insertions thereon Thickening of tuberosity of right tibia, exostosis of head of astragalus

Heads of metatarsal bones thickened as in arthritis deformans. Left leg shows similar changes as right one, osseous mass extending from popliteal fossa down between the two bones and immobilizing knee-joints. Thickening and ankyloses of ankle-joints. Ankyloses of big toes, from the tip a long bony appendix is branching off, size of a walnut, like a supplementary toe. In the discussion of this case Gerhard drew attention to the microdactylia of a big right toe. Case began rather late in life, but except this one symptom, has all the earmarks of the disease. The epiphyses of the long bones are so soft that pins can be pushed into them

CASE XLIX-Reported by A A Kisel, in 1893, 1906-1909 Male, aged I year and 7 months (13 years?—16 years?) Family history negative First symptoms appeared at I year of age-swelling in nape of neck size of small walnut, no accompanying pain or inflammatory symptoms. After three or four weeks most of tumors disappeared without leaving any trace Some others seemed to soften and discharged a puriform liquid All without symptoms of inflammation has been drawn forward and posterior part of neck has become very rigid and quite Impossible to turn head backward Head drawn forward Chin touches Motions of head very limited The entire posterior part of neck appears considerably swollen, the borders of the muscles very much thickened The sternomastoid and pectoral muscles present some changes Movements of right shoulder yery limited, especially abduction and elevation April 25, 1893, a new tumor appears in the right flank, with the same character as the others and reaching size of a small walnut When 16 years old bone-like hardening of ant and post cerv muscles, muscles of thorax, scapulæ, shoulders, abdomen, osteal attachment between twelfth rib and crista ilii, exostoses on lower jaw and scapular spine, head inclined forward and to the left, and immovable, head, vertebræ, neck, thorax and upper extremities in shoulders all one mass of bone, limited movement in elbow-joint. Improvement at first At 13 years walked well, but now unable to leave bed of small tumors, tumor shows muscle cells much swollen, reddish-yellow and ædema-Microscopical examination, very young embryonic tissue cells large starshaped cells with various-formed processes, very few striated muscle fibres, very much modified Microdactylia of both big toes, with aplasia of first phalanx (?)

Case L—Reported by Weldon Carter, in 1894 Male, aged five years Family history neg First symptoms appeared at 4 years of age—lumps in back. Never any complaint of pain or tenderness or inflammatory symptoms. Back and shoulders affected, especially latissimi dorsi. Both big toes in hallux valgus position, the phalanges of fourth and fifth toes were very short and slight webbing between second and third toes of each foot

Case LI—Reported by Carl Hochhalt, in 1894 Male Family history neg First symptoms appeared at 19 years of age—pains and swelling in right triceps brachii. Pains and swelling gradually disappeared after three months, leaving osseous hardening, similar attacks repeated annually, involving new groups of muscles. Spinal column is rigid and ankylotic in all its articulations. The muscles of the back are changed into hard bony plates, especially both cucullaris and latissimi dorsi, exostoses trunci, mimic muscles of face intact, masticating muscles rigid. In order to allow nutrition patient had several teeth broken out. Pushes nourishment through gap. Both shoulder-joints stiff, both triceps changed into hard bone masses. Under left gastrochemius large bony mass size of one and a half fists reaching partly up into popliteal fossa, contracting knee-joint. Left glutæus changed entirely into shapeless bony mass. No congenital abnormalities mentioned.

Case LII—Reported by E Lexer, in 1895 Male, aged 50 years Family history neg First symptoms appeared at 35 years of age—pains in left side of chest Pains disappeared after three weeks, leaving soft-covered nodules the size of hazelnuts at the painful places These nodules also disappeared after a short time. In 1884 again pains in left side of chest and back. Soft swelling in left lumbar region size

of palm of hand Later grew smaller and harder Till 1888 recurrence of symptoms every summer The lumbar swelling grew larger and harder and spread in front and upward to the axillary line He again fell sick in 1890, then remained free until New nodules had formed and a very severe recurrence took place, with pain in both shoulders and in muscles of both upper arms. In the lower part of the pectoralis major a cartilaginous nodulous tumor, size of a hen's egg. At the margin of the trapezius muscle, level of sixth cerv a similar but smaller tumor deltoid a growth size of a man's fist, of fibrous consistency, covered by muscle and slightly movable over the underlying bone. Both upper arms show under atrophic biceps a cord-like, bone-hard mass, movable on humerus and occupying the place of the brachialis internus. The right forearm shows in its middle a bone-hard growth about 5 cm long and wide, movable sideways under the supinator longus of the other muscles show peculiar indurations. In the back the left latiss, dorsi nearly entirely pronated by a tumor formed by the amalgamation of a number of smaller ones, which reach from the crista ilii to the vertebral column and up to the scapula In the region of the left infraspinatus a very large free tumor from spina scapulæ reaching to the acromion. In right serratus, over fifth and sixth ribs, a very hard flat tumor No deformities of fingers or toes (specially mentioned) deltoid tumor Ten days later the tumor over fifth and sixth ribs was excised Patient left clinic December 6, 1894 Letter of March, 1895, mentions several muscles of neck and lower extremities involved Microscopically the sections show acute and chronic inflammation and induration of the inter- and intra-muscular connective-tissue (perimysium) hypertroph changes from which the formation of bone tissue starts Atypical case Commencement of disease very late Ossification not shown

CASE LIII -Reported by Stephen Paget, in 1895 Male, aged 71/2 years Family history negative First symptom appeared at 4½ years of age-swelling behind left ear Since that time various swellings and growths have appeared, some disappeared again, while others remained in different parts of his body head in wry-neck position from contraction of left sternocleido A small nodule of bone in the anterior edge one inch above clavicle. In each pectoral muscle irregular bony nodules moving with the muscles. In the right pectoral they are dispersed all through the substance of the muscle and continuous with plates of bone under the deltoid and along the latiss dorsi Latiss dorsi contains a sharp bony ridge in the axilla, the serratus magnus shows hard nodules at its origin bony masses in the I pectoral are also continuous with bone in the fascia beneath Along each side of spinal column a hard bony ridge, more marked on left than right side, seemingly part of latiss dorsi. From ant fold of each axilla a narrow hard cord, thickness of about No 5 English catheter, runs right down the level of iliac crest, they are not bony Both big toes are shortened and turned outward in metatarsal phalangeal joint, and the phalanges turn under the second toes (Microdactylia-hallux valgus)

Case LIV—Reported by Fuerstner, in 1895 Female, aged 15 years Family history neg First symptoms appeared at eight years of age—nodules size of pigeon eggs appeared and disappeared again after five or six weeks. Since the age of eight or ten months hindrance in motions of neck and arms from nodules appearing in these regions. Position of head and vertebral column stiff, rigid walk. All movements of head very limited through tension of hardened but nowhere nodulated muscles of the neck. In the long muscles of the back, however, there are several hard bony thickenings. At the inner margin of the scapula there are several osseous protuberances and bony plates in the latiss dorsi. The arms are flexed most of the time, cannot be abducted, as tendons of pectorales major are hard cords. Both biceps muscles are hard as well as presenting a peculiarly sharp tendon, the lower parts of triceps feel ossified. On the left side the same changes are present in a lesser degree. Abdominal muscles and lower extremities show but slight changes

During observation of this case a swelling occurred in the left biceps muscle within a few days. It was of a doughy consistency, the skin was slightly reddened and there was considerable pain upon pressure. A small piece of the biceps muscle was carefully excised and the inicroscopical examination showed a very pronounced and intense hypertrophy of the interfibrillary connective tissue, especially in the neighborhood of the blood-vessels, while the muscular tissue itself remained completely unchanged. Both thumbs and little fingers considerably smaller than normal. Microdactylia of both big toes

Case LV (?)—Reported by Eichhorst, in 1895 Male, aged 24 years Family history neg First symptoms appeared during time of observation in hospital—swelling and hardening of muscles of left calf Subsequent course of disease unknown The swelling extended from the upper end of Achilles tendon 5 cm into the muscles of the calf Skin at first red and inflamed, afterwards resumed its natural state While the affected parts of the muscles decreased somewhat in size they so increased in hardness that they felt like bone, the skin was movable over them, and in so doing crepitation was distinctly felt. Patient had spina bifida. No change of condition was felt when patient left hospital or was observed later, no progressive ossifications in other muscles. No deformity of fingers or toes. This, as well as the former case reported by Eichhorst's assistant (No. 37), is a doubtful, atypical case.

CASE LVI -Reported by O Paget, in 1895, and W P Herringham, in 1899 Female, aged 5 years Family history neg Said to have suffered very intensely First symptoms appeared three weeks before date of examinationlump in back, which gradually increased in size more rapidly since the last week Subsequent course of disease unknown Head fixed by two indurated nodules and hard sternocleido Right pectoral, left pectoral and latiss dorsi all in same condition General health fair (pigeon-breasted), two growths, smooth, oval and firm, about 4 x 2" symmetrically on each side of vertebral column just below inferior angle of scapula Similar growth, size of large walnut, attached to inferior angle of each scapula Ossified node on external edge of right bicipital groove Ossified node on forehead, the latter due partly to mability of child to protect itself when falling forward Bilateral microdactylia of big toes ascribed to absence of first phalanx Observation in 1899 shows marked progress of disease on skull, abdominal walls and both ulnæ, movements of shoulder very restricted Skiagram of big toes shows microdactylia and hallur valgus, due to (1) Irregularity and shortness of metatarsal bones, (2) thickening of outer side of first phalanx, tilting bone outward, (3) synostosis of the first and unguinal phalanx at oblique angle Exostoses on first phalanx of the right middle finger

Case LVII—Reported by Harry Lockwood, in 1896, and Raymond Crawford, in 1899 Male, aged 4½ years Family history neg First symptoms appeared at 2½ years of age—German measles shortly before malady showed itself Subsequent course of disease unknown Body and head bent forward Masseters hardened, right and left pectorales major ossified and fixed Large masses of hard material on both sides of spine Microdactylia of thumbs and toes

Case LVIII—Reported by Zoege v Manteuffel, in 1896 Subsequent course of disease unknown Demonstration of a skeleton of a case of myositis ossificans progressiva, where the products of the disease could be seen from head to foot. The osseous neoformations correspond to the course of the muscles. They had developed in their connective tissue nearly everywhere independently of the skeleton, so that they could not be ascribed an exostoses. A synostosis of the shortened phalanges of the big toes. The thickening of the mandibulæ seemed to be caused by an ossification of the muscular insertions. Microdactylia

CASE LIX—Reported by Ludwig Pincus, in 1897 Male, aged 25 years Family history neg When 13 years old fell on back from a height of two metres First symptoms appeared at 14 years of age—observed in nape of neck two little

nodule-like glands, but they disappeared later spontaneously. Later back, shoulders and left arm again attacked after trauma. Causes of attacks are generally traumatic. After a prolonged quiet an attack of violent pains and swelling, first on the left, then on the right side. Disease particularly pronounced in neck, back and surroundings of neck, surroundings of axillary fossæ, masseters, upper arms and thighs. Scoliosis, caput obstipum, exostoses and hyperostoses. The right carpo-metacarpo articulatio pollicis ankylotic, thumb smaller than normal. Microdactylia of both big toes, with hallux valgus. Faradic contractibility diminished. Strong fibrillary spasmodic contractions spontaneously, but more pronounced when touched. Venous stasis, especially in legs.

CASE LX -Reported by Von Kryger, in 1898 Female, aged 41/2 years history negative First symptoms appeared at 21/2 years of age-with inflammatory symptoms, a painful bluish-red nodule formed on back a little to the left The first tumor decreased greatly and in its place a of twelfth dorsal vertebra round osseous protuberance appeared At various times this process, nearly always accompanied by inflammatory symptoms, spread over back, nape of neck and vertebral column, abdomen and hips. At last face and neck were involved vertebral column emanate long irregular bony ridges, shoulders drawn up, lower arms flexed at right angles, only slightly movable. Hands crossed across the abdomen, legs slightly flexed at hips, right one abducted, immovable Head inclined toward front and left, face turned somewhat to right, muscles of the cheek and mouth are very hard and mouth can be opened only half an inch Everywhere in muscles one finds tough cords or bony ridges, some of which are connected with the skeleton, others appear to lie free in the tissues and nearly always follow the course of the fibres, rarely crossing them From the ribs, the vertebræ and the pelvis real exostoses project vertically to the skin Microdactylia of both big toes to have only one phalanx, which stands in valgo position upon the metatarsus X-ray picture)

Case LXI—Reported by Walter Stempel, in 1898 Female, aged 7 years (?) Family history neg First symptoms appeared at three and a half years of age—swelling in sternocleidomastoider, later in cucullaris and various other muscles of thorax and body. Swellings felt hard at first, got gradually softer and disappeared, as did many other hard swellings in various groups of muscles during the course of three and a half years of observation. Last examination, January, 1898, showed ossification of both cucullares at occiput. Ossification of scalent Spine quite stiff. Fination of lower jaw through hardening of masseters. Microscopical examination of muscle in first stages of hard swelling showed a hypertrophy of the outer fibrillary tissue, which by its rapid growth into the muscular tissue, separating and pulling the muscle fibres, causes an intramuscular hemorrhage, which, according to Stempel, represents the first cause of the swelling which is being followed by the fibrous tissue growth and later by ossification

Case LXII—Reported by A Roth, in 1898 Female, age (?) Family history neg First symptoms appeared between I year and 9 months and 2 years of age—swelling in left side of middle of back. Another swelling at the left side of the neck followed closely, both disappeared after inflammatory symptoms. A similar process developed on the right side of the back, followed by swellings of both arms from shoulders to elbows and of various other places, like chest, abdomen and thigh After a recedence of the inflammatory symptoms the afflicted parts showed hard exostoses-like masses. Arms grew stiff and lately the face became swollen. Patient perfectly stiff, as if in tetanic rigidity. Two small exostoses, size of peas, above left ear. Maxillary joints ankylotic. Mouth can be opened only ½ cm. The entire cervical muscular group forms one hard mass. The upper arms are bound together by a hard bony ridge in the anterior and posterior height of the axillary folds, comprising latiss dorsi and pectorales major. Both scapulæ are fixed. Superior

and inferior scapularis of osseous hardness. In both upper and lower arm muscles various ossifications and enclosures of bone. Muscles of hands free, narrow strip of bone in musc obliq abdom ext. On both sides, at origin of sartorius, ossification Microdactylia of both big toes. Valgus position, only one phalanx reaching to first interphalangeal joint of second toe. Microscopical examination of a piece of newformed osseous tissue shows the change of connective tissue to fibrous, cartilaginous and bony tissue. He believes in passive and active participation of periosteum, as he found hardly any bony pieces free in the muscular substance, also in a congenital diathesis brought into action by traumatism

Case LXIII—Reported by Mr Jacoby, in 1898 Male, aged 27 years Family history neg First symptoms appeared at 19 years of age—pains in ankle-joints and legs Four years later pains occurred in hips and neck, and only two and a half years ago induration and ossification in the neck, involving all the contour of the neck Another ossified mass between pelvis and lower edge of arch of ribs Slight hardness in masseters, but patient can still open mouth well. July 14th diagnosis confirmed by X-ray pictures characterized it as a bone-muscle disease, which leads to the formation of exostoses and direct ossification of the muscular connective tissue. No mention of congenital abnormalities

CASE LXIV -Reported by A Salomoni, in 1898 Male, aged 12 years Sound. healthy parents First symptoms since birth-deformities in neck and arms Gradual and steady progression. At the time of first observation, in 1897, deformities had greatly progressed. They occupied the entire neck and the two upper limbs in a very characteristic manner A personal letter from Piacenza, Italy, where Salomoni is now head of a military hospital, explains that on account of being so taken up with his present duties he is unable to go further into the history of this case, and merely gives me what data he remembers He says "I extirpated from the neck and from the arm two pieces of the muscles where ossification had gone on logically demonstrated to be derived from the fibro-connective tissue and from the new-formed bone near the periosteum. The little patient underwent various pharmaceutical treatments, more for the moral effect than for any other purpose, and died at the age of 14 without my being able to continue the observation of his case" This case was reported in the record of the congress of the Italian Surgical Society of Turin, 1808 Salomoni's letter differs from the above-named report and that of the Italian Pathological Society in 1898, which reads "A girl, 7 years, when 2 years old ossif of 1 sternocleido noticed, later r side, then gradual swelling and ossif of other muscles, sometimes with fever Microdact of thumbs and big toes"

CASE LXV -Reported by Hendrick Burgerhout, in 1898 Male, aged 40 years Family history neg First symptoms appeared at birth-left shoulder-blade and left shoulder-joint stiff During schooling years hip- and knee-joints became stiff Later. after twentieth year, both elbow and wrist-joints stiffened Ten years ago both maxillary articulations became stiffened so that he could not open mouth Sits nearly immovable, head bent forward upon chest. Lower jaws very slightly movable Distinct movement of temporales and masseters Sternocleido and cucullaris feel hardened, but not osseous Arms stand in strong adduction, scapulæ fixed, at lower outer angle not separable from the stone-hard mass which goes in the direction of teres majores and latiss dorsi. The long muscles of the neck are connected from neck to os sacrum by irregular ridges of bone Left arm, shoulder and elbow stiffened. left thigh flexed in hip-joint, left knee-joint and ankle-joint immovable exostoses above patella in location of vast externus Right leg articulations resemble left side, but are freer On inside of femur in place of adduct hard exostoses extending from pelvis to insertion of adductor magnus. Microdactylia of thumbs and big toes due to smallness of metacarpal and metatarsal bones. Very exact examination of electric irritability of muscles and their nerves, both normal For very thorough metabolical research work and conclusions of this case see text

Case LXVI—Reported by Robert Jones, in 1899 Male, aged 16 years Family history neg Fell and injured his back (?) First symptoms appeared at 13 years of age—growths on back started one year after his fall. Subsequent course of disease unknown. Growths on inner aspect of right jaw, small lump below right olecranon. Hard mass attached to upper two-thirds of femur, thickening at insertion of right ligamentum pateliæ and at each tarsometatarsal joint. Over spinous processes a continuous line of hard cartilaginous or osseous material, extending from level of fifth dorsal to fourth lumbar spine. Strips projected from the upper and lower ends of this mass two and three inches long. They were movable in the surrounding tissues. No deformities mentioned.

Case LXVII—Reported by Morian, in 1899 Male, aged 4½ years Family history neg Fell twice down a flight of fourteen steps. First symptoms appeared at 2½ years of age—soon after second fall swellings in various muscular groups. Fell again after commencement of disease and struck on a stone with his neck. Ossification in right frontalis muscle, in both sternocleid, in the group of muscles from sternum to hyoid and from there to mandibula, in both pectorales major and deltoids, in both sacrolumbales and in both bicipites, in both cucullares and right altissimi dorsi. Both big toes show microdactylia

Case LXVIII—Reported by Lyder Nicolaysen, in 1899 Female, aged 4½ years Family history neg First symptoms appeared at 2 years of age—stiffness of shoulder, neck and back Subsequent course of disease unknown Height 99 cm Circumference of chest 45 cm Posture head bent forward, nape of neck, back and shoulder muscles completely ossified In both axillary fossæ anterior and posterior folds are hard, greater part of pectoral maj ossified Both scapulæ fixed to thorax Trapezius bone-hard Several nodular exostoses on back Arms stiff and rigid Hardened parts in musculature of upper arms Excursion angles of both forearms about 45 degrees Microdactylia of both thumbs and big toes

CASE LXIX-Reported by George Wilkinson, in 1900 Male, aged 13 years Family history neg First symptoms appeared at 21/2 years—swelling in right side of back. Swelling in back subsided Later isolated hard lumps appeared on back, remaining and spreading Later stiffness in back Lower jaw fixed, mouth can only be opened one-fourth inch, due to hard temporal fascia. Bony bars in right occipital bone Thin plate of bone in occipital tendons and left trapezius, and hardening in right. Hard nodules in both sternocleidin and scaleni muscles Big bony mass extending from left to right scapula Two large hard masses in right lat, shoulders raised, scapulæ fixed Nodule in left pectoral maj, two small ones on both sixth ribs Respiration wholly diaphragmatic, shoulder movements, especially rota-On each femur large irregular mass of bone fixed to the upper end near great trochanter A spike of bone extends on each side of glutæus maximus near its sacral origin. Another one down along outer side in tendon of fascia lata to below middle of thigh Hard nodule in right rectus femor Sharp nodule of bone projects below each tuberosity ishii Angular bony nodule on posterior border of right tibia, three inches above int malleolus Movements of hips limited Trunk bent somewhat forward, can sit only on corner of chair Both thumbs microdactvlic Their metacarpals and phalanges are shorter than those of other digits and interphalangeal joints stiff Both big toes microdactylic and with hallux valgus two phalanges very short, their interphalangeal joints synostotic, nodules have formed without pain Some masses that have appeared during the nine months of observation have disappeared again

Case LXX—Reported by Morley Fletcher, in 1900 Male, aged 9 years Family history neg First symptoms appeared at 7 years of age—location (?) Subsequent course of disease unknown Numerous exostoses on bones of head, one on the hand and one on each tibia. Thickening of bridge of nose Both big toes small and terminal phalangeal joints ankylosed Interesting association of numerous exostoses with

multiple neuro-fibromata, looks upon it as abnormal condition of mesoblast from which the mesoblastic structures were formed and as related to the condition of multiple exostoses and multiple neuro-fibromata

CASE LXXI —Reported by Theodore Schwickerath, in 1901 Female, aged 14 Family history neg First symptoms appeared at 9 years of age-violent Two molars were extracted, whole left side of face swelled greatly after extraction of teeth and became permanently stiffened Patient's jaws became so stiff that she could not open her mouth sufficiently for mastication A piece of an osseous ridge 1 cm broad and 1/2 cm thick was removed from the left masseter to increase the possible excursion of the lower jaw operation mouth could be opened 3 cm, but later it returned to almost its preoperative status Patient holds herself bent forward Scar on left masseter where excision was made Near upper insertion of left masseter a firm nodule, size of cherry pit, in its lower part an osseous ridge 11/2 to 2 cm broad Lower jaw can only be opened 2 mm Lateral movements entirely inhibited Left clavicle enormously Left sternocleido a thick cord, shows osseous ridges in sternal and thickened clavicular portion of the pectoral maj, is as hard as bone, running toward axilla and ending at spine of tuberosity maj. In the middle of right scapula spine is an Back scoliotic to left and shows partly flat, partly osseous nodule size of a walnut On both sides of vertebral column osseous plates, in latiss osseous protuberances dorsi and teres osseous nodules extending right down to region of sacrolumbalis Right arm very few excursions possible, adduction, abduction and rotation impossible, in the axilla a hard nodule Left arm nearly normal, right thigh exostotic thickenings Microdactylia of both big toes No X-ray picture

CASE LXXII—Reported by Vaughan and Burton Flanning, in 1901 33 years Father had same disease, dating from a fall in his fifteenth year on his right arm, where it began The disease had steadily progressed, but had not reached the same degree as with his parent, when he died at the age of 33 from an accident He had congenital deformity of both thumbs, there being no joint beyond metacarpal ones Feet were not observed First symptoms appeared at 8 years of age-left shoulder gradually became stiff without any previous injury or pain 12 years right knee began to stiffen and gradually became ankylosed Following this came stiffness of left hip, sides of chest and lower part of back. At 26 years right arm from shoulder downward became swollen, red and tender This disappeared. but left arm is fixed extended in shoulder and elbow Wrist remained free years later stiffening of right hip was noticed. During winter of 1898 difficulty in opening mouth began, passed off during summer, but returned worse the following The following summer got slightly better, but had gradually increased since Both erector spinæ nearly completely replaced by bone, preventing any movement of that portion of the spine covered by them Deep muscles of back of neck similarly affected, only possible movement of head is slight rotation and flexion plates between several ribs, on each side and along ant border of 1 quadrat lumb was hard band fixing twelfth rib to crest of ilium. Movement of chest almost prevented by these growths except over first two ribs The distal halves of both teres maj and pect, maj were bony Close over the right fossa olecrani a bony mass, the size of a walnut, involved the whole thickness of the triceps A similar growth over the upper ends of the ulnæ and radii Both extens quadriceps were almost replaced by bone, osseous growths round head of right fibula and enlargement of both int malleoli Both big toes had hallux valgus, with shortening and broadening of phalanges, which were fused together No X-ray

CASE LXXIII—Reported by Wilhelm Rager, in 1901 Female, aged 14 years Family history neg First symptoms appeared at 2 years of age—swelling over os frontal After that many painful inflammatory swellings in various parts of the body, leaving osseous hardenings Mouth can only be opened 1½ cm Both shoulder-

Joints and right elbow-joint ankylotic Ossification in both masseters, right sternocleido and platysma, both deltoids, pectoral maj and latiss dorsi, quadriceps femoris, right soleus and insertions of both gastrocnemii and solei Similar ossifications are distributed all over back of neck and the back proper down to lumbar vertebræ Both thumbs and big toes are deformed, only half as long as normal In the thumbs, due to two shortened and synostotically united phalanges, in the toes to stunted metatarsal bones

Case LXXIV—Reported by Christopher Graham, in 1901 Female, aged 6 years Family history neg First symptoms appeared at 4 years of age—small lump between shoulders Gradual but steady progression Rarely any pain except during last three or four months Ligamentum nuchæ solid throughout Both pectorales and sternocleidi are more or less solidly ossified Right biceps affected in its entire course, the left only in its upper part Right trapezius is completely changed into bony mass, the left less so Both latiss dorsi are ossified. The deeper trunk muscles seem to be also similarly affected. Right external oblique ossified along the line of the linea semilunaris, below and externally from Poupart's ligament, a hardness and nodules can be felt. No microdactylia mentioned. Upon my inquiry, Doctor Graham kindly answered that he had no recollection of having examined the feet, the boy having been seen in the policlinical department only.

CASE LXXV—Reported by H D Rolleston, in 1901 Male, aged 8 years Subsequent course of disease unknown Ossification in both sternomastoids and posterior scaleni muscles and in the scapular attachments of the rhomboids. Bony plates in lower parts of latiss dorsi. Hard masses in region of erectores spinæ over lumbar spine. Both biceps and brachialis ant muscles extensively ossified. Both recti abd are affected. Exostoses on both tibiæ near insertion of sartorius muscle and on both frontal bones. Microdactylia of both thumbs and toes, due to dwarfing of metacarpal bones. Commencing ankyloses of interphalangeal joint. Both hallux valgus, with exostoses. Exostoses on first phalanx of right middle finger. (Same peculiarity in Doctor Herringham's case, No. 56.)

CASE LXXVI-Reported by George Carpenter and Walter Edmunds. in 1901, and Cyril Nitch, in 1908 Female, aged 4 years Family history neg toms appeared at 31/2 years of age-two weeks after both tonsils were removed a hard and tender swelling appeared on right side of neck. The first swelling subsided after a couple of weeks. Two weeks later a swelling appeared on left side, which also disappeared again. A short time afterward the mother noticed a hard mass on right side of neck, and a few months later similar bumps in left pectoral, scapular and lumbar region Condition in 1901 Spicule of bone in left sternocleido The neck muscles of same side infiltrated and hard Below chin bony infiltration size of pea in geniohyoid muscle Plates of bone can be felt in right sternohyoid, right coracobrachialis, left pectoralis major and erectores spinæ February, 1005 back and neck quite rigid, movements of shoulders very limited pea-like prominence of bone in geniohyoid has now become a long spinous process Osteoid tissue in form of plaques, bosses and spicules can be felt in both erectores spinæ, latiss dorsi, trapezii and pectorales, right rhomboideus major and minor, the sternomastoids, right vastus externus and in popliteal space Microdactylia of both 1901 excision from a muscle that showed gray infiltration revealed under microscope fibrocellular tissue infiltration, no micro-organisms

Case LXXVII—Reported by Menard and Tillaye, in 1902, and Comby and Davel, in 1904 Female, aged 5½ years Family history neg First symptoms appeared at 17 months of age—swelling (where?) Swelling always preceded hardenings and ossifications (where?) Osseous hardenings in post cerv regions and down the back to right axilla, extending toward thorax and to the inner border of humerus and also to the dorsalis maj On the left side similar changes in the trapezius Two and a half years later slow, but steady development of new osseous hardenings

Stalactite formations in axilla, reaching down along humerus to elbow. Head, arms and back stiff, and movements extremely limited. The thumbs and little fingers of both hands as well as the two big toes are undersized. (Microdactylia.) Woodcuts of hands in later observation show microdactylia of thumbs depends on shortness of metacarpal bones. No X-ray in either communication.

CASE LXXVIII -Reported by Fabio Rialta, in 1902 Female, aged 16 years Family history neg Father suffered for thirty years from arthritis of the left First symptoms appeared at 2 years After vaccination Vaccination (?) swellings appeared on head, from size of pigeon's to hen's egg The entire left arm became swollen, then subsided The same occurred then on right arm Later both arms contracted, with flexion of forearm and adduction of upper arm and inability A gradual, continual increase of all these symptoms swelled and remained stiff After swelling had subsided some hard indolent nodules developed over the dorsal spine of the scapula the size of those on the head From the superior dorsal region these formations descended, increasing in number every spring for about twelve years until two years ago, when they stopped Height 138 cm Head flexed rigidly toward right and forward, neither active nor passive rotation, extension or flexion of head possible Vertebral column equally rigid, muscles of neck atrophic, sternocleido contracted and hard. The posterior cervical ligament ossified, with osseous plate, another one runs from seventh cervical downward, ossification of left levator scapulæ and cucullaris. The tendon of the pectoralis major is ossified to its insertion Arms crossed over chest, forearms in exaggerated flexion. osseous plates in biceps, the caput brevis completely enveloped with an osseous growth the size of palm of hand The anterior wall of axilla also ossified and posteriorly is an ossification extending on both sides from dorsal maj to scapular angle and to vertebral column R biceps has ossification similar to but less pronounced than left Processi spin below seventh dorsal are hidden by ossified masses Column is slightly scoliotic and absolutely rigid Respiration completely abdominal, slightly thoracic at base External genitals normal in size, but hairless Microdactylia of both big toes Shortness of first metatarsal bone and hallux valgus Hemidrosis facialis (sinistra)

Case LXXIX—Reported by M Ferraton, in 1903 Male, aged 18 years Family history neg First symptoms appeared at 3 years of age—previous to first swelling in scapular region a three months' period of pain, sleeplessness and loss of appetite After swelling subsided ossification set in Ossification of right masseter, left more atrophied Right sternocleido hard, the greater part seems to be ossified Pect maj and deltoids contracted and atrophied On the right humerus anteriorly two round exostoses, size of hazelnut, firm upon the bone, on the left side similar outgrowth Another exostosis on the pelvis on crista iliac post to its edge, close to ossified insertion of dorsalis maj Several large ossifications on the inner side of the right thigh, under middle and large adductors Right foot second toe much larger than the others, microdactylia of big toe, on left foot a synovial bursa on first phalanx of big toe Hallux valgus (No X-ray) Operation on masseter muscle, exsection of small piece of muscle Patient can open his mouth

Case LXXX—Reported by Julius Michelson, in 1904 Female, aged 18 years Family history neg First symptoms appeared at 7 years of age—both thumbs over both flexor brev hot and inflamed Later thumbs grew stiff and nearly immovable Kyphosis and scoliosis at cervical and dorsal spine Cervical spine stiff, only minimal movements possible in rotation, extension and flexion Same conditions prevail in dorsal and lumbar portions Muscles of neck hard (X-ray shows no ossification) Pars clavicularis of left pectoralis maj shows bony deposit extending over the shoulder-joint and into the axilla, this mass can be moved to and fro A similar mass is on the right side Both thumbs are ankylotic between first phalanx and metacarpus The little fingers are shortened (Second and third phalanges

are shortened) Both big toes are 2 cm shorter than normal and their two phalanges in firm osseous union. The little toes also are shortened and their second and third phalanges ankylotic.

Case LXXXI—Reported by Clito Salvetti, in 1904 Female, aged 4½ years Family history neg. First symptoms appeared at 10 to 12 months of age—swelling observed in the left cervical region. This swelling disappeared, but was followed by two elastic swellings on the occiput, which persisted until now. Neck stiff Hard infiltrations of muscles back of both supra- and infra-spinosi, and tumor-like indurations size of hen's eggs. Left pectorals like an inflexible plate, preventing the shoulder movements entirely and those of the forearm partially. The left Mohrenheim fossa absent. Neither fingers nor toes show microdactylia. (Specially mentioned.)

CASE LXXXII—Reported by A P Beddard, in 1905 Male, aged 37 years Family history neg First symptoms appeared at 7 years of age—bony growths began to develop in muscles Subsequent course of disease unknown Bony growths can be felt in innumerable parts of his muscular system. Some of them are movable within the muscles, the majority are fixed, having developed in tendons and insertions of muscles. Ankylosis of joints has developed to such an extent that patient is entirely helpless and absolutely bed-ridden. No mention of microdactylia

CASE LXXXIII—Reported by A Gaster, in 1905 Male, age (?) Grandfather father and three sons were afflicted with same disease Subsequent course of disease unknown Doctor Gaster states in the discussion of Doctor Beddard's case (presented by Doctor Russel) that he knows a family in which the father and grandfather had myositis ossificans progressiva. The three sons suffer from the same disease. Mother and two daughters are free from it, two sons have two baby daughters without a trace of the disease.

Case LXXXIV—Reported by Nove Josserand and Rene Horand, in 1905 and 1912 Female, aged 7½ years Family history neg First symptoms appeared at about 6½ years of age Subsequent course of disease unknown On both sides of scapulæ a tumor size of mandarin, the right a little larger than the left Osseous indurations on the trapezius and in the upper part of right sternocleido. In lumbar region an osseous plaque near the iliac crest. In right and left pectorales major and minor are ossifications. Both big toes are shortened and show hallux valgus. Last phalanx of each little finger is noticeably turned outward. In 1912, on account of progression of disease, patient was induced to submit to X-ray treatments. Had twenty-six treatments, all below five Holzknecht's units. Effect surprising, patient straightened out, can again walk with youthful agility up and down stairs, sit and lie down unaided, and is no more imprisoned in her shell. As to duration of this improvement, author promises watchful waiting.

Case LXXXV—Reported by S Biegel, in 1906 Male, aged 7 years Family history neg Born in occipital presentation, was delivered with forceps, large hæmatoma over occiput (?) Head at first drawn out lengthwise, but after few days normal shape restored. First symptoms appeared at 3 months of age—parents observed apparent displacement of parietal and other bones of skull, and a little later swellings on head size of pea to a marble. These swellings disappeared after a few weeks. Previous to appearance of swellings on top of head and on neck there was always stiffness vertebral column and cyanosis of head and of extremities, which again disappeared as soon as swellings were fully developed. This lasted with intervals to his third year. From third to sixth year he was quite well, although a slight knock or a slight fall always produced hard nodules, which disappeared again after a few days. About one and a half years ago he fell upon his head. From this time on he grew stiff. Can now hardly move. At first his neck grew stiff and he could not turn his head. Later maxillary muscles stiffened, mouth could not be opened more than enough to admit flat spoon. This condition improved so that he

could open his mouth again, but stiffness developed in the muscles of his mouth September, 1905 a stone-hard thickening of both sternocleider, December, stiffening of upper arm and thorax muscles of both sides, in left side osseous ridge remained Head bent to left side and forward, breast and abdomen bent backward and to the right. Both sternocleider and platysmæ feel like hard plaques. From left side of axilla a bony ridge goes over pectoralis major, serratus ant maj, obliquus ext abd Both cucullaris are hard, the edge of the scapulæ strongly, projecting. The right arm hangs along the side of the trunk and the hand rests on the thigh, the left is abducted in shoulder-joint and flexed in elbow so that the hand rests nearer to Poupart's ligament. Both are limited in their movements, the left more than the right. All the hand and finger-joints are well movable. Both legs are flexed in hip-and knee-joints. Hip-joints are stiff, but below these joints limbs are well movable. Microdactylia of both thumbs and big toes.

Case LXXXVI—Reported by E J Maxwell, in 1907 Male, aged 10 years Family history neg First symptoms appeared at 5 years of age—hardness of spine muscles Gradually increasing ossification of muscles of spine near the sacrum and back, spreading upward Spine and head absolutely rigid, growths of bones branched out from spine to scapula Breathing mainly abdominal Only liquid could be swallowed, condition of masseters and jaws not given Bone could be felt on right side of larynx No mention of microdactylia No X-ray picture

CASE LXXXVII -Reported by A E Garrod, in 1907 Male, aged 21 months (weight 23½ pounds) Family history neg First symptoms appeared at 3 or 4 months of age-lumps appeared on head Child healthy at birth, but soon began to waste Improved to normal condition, however, when nursed by colored woman The lumps disappeared completely three or four months later. At 16 months fresh swellings appeared upon back, increasing in size for some time, then disappeared again, while fresh swellings had appeared in new locations Swellings upon back, two in front of chest in outer parts of pectoral muscles, one on the head over occipital Swellings disappeared and new ones came during the time of observation, May 29, 1906, to July 20, 1906 Patient left without any bone formation having occurred in any of the swellings during this first period of observation, no constitutional disturbance or particular pain seemed to accompany the appearance of the swellings One year later reported right biceps is contracted and feels stony hard. stiff elbow and right shoulder-joint A lump size of mandarin orange over infraspinatus, of ivory hardness Other lumps forming Health seems to be perfect dactylia of both big toes in valgus position. Over the inner aspect of the head of each first metatarsal bone was a small linear scar, suggesting that an extra digit had been removed

CASE LXXXVIII -Reported by Paul Krause and Max Trappe, in 1907 Female, aged 161/2 years Family history neg Severe cold (?) First symptoms appeared at 121/2 years of age-tired feeling in arms and legs, and back began to feel stuff Pains in various parts of her body, knees sensitive to pressure, stiffness of legs increased, arms became bent and stiff About the winter of 1905-06 appeared a swelling in lower sacral region, which disturbed the patient when lying down bone-hard nodule was removed from right ant axillary wall, since then she can move right arm better than left. A swelling of the feet appears now from time to time, but soon disappears again The swellings when softened evacuated an emulsion of amorphous calcium salts Later the skin became sclerotic, dry and immovable over its underlying tissues Patient 155 cm tall, weight 345 kil Very strongly developed arcı zygomatici and large pupillary distance (65 mm) Slight left scoliosis in lower dorsal and lumbar portion Pect tendons are hard as board, contain several nodules hard as cartilage Scapulæ show over spinæ several small tough nodules, over right acromion a hard tumor size of a cherry pit In upper and lower parts of both biceps are several small nodular imbeddings In right cubital fossa a

collection of nodules connected with the lacert fibrosus, continuing to the forearm, on the left only one small nodule Hands show nothing abnormal Over right sacroiliac joint nodule of bony (?) consistency, size of millet grain, and to the left of the spinous process of fourth and fifth lumb vert. a soft swelling, size of a silver dollar, sensitive to touch On both sides of os coccyx three globular swellings about 21/2 cm In the gluteal muscles small nodules size of cherry pits The adductors at their origin, at os pubis, as hard as board. At the inner epicondylus of the left thigh two nodules of cherry-pit size adherent to skin and movable with it over the underlying tissue Toes all well developed. The microscopical examination of the excised axillary nodule showed only a sort of fibrous hyperplasia and infiltration of the muscular tissue The late beginning (121/2 years), after a cold, the absence of new pathological cartilage- or bone-formation or even of calcification in the X-ray pictures or in the excised nodule, the softening, liquefaction and discharge of thick, mucous emulsions, the dryness, sclerosis and immovability of the skin, the absence of microdactylia-all these features do not fit into the picture of myositis ossificans progressiva, but stamp the case as belonging to myositis fibrosa Since writing I found that in a later article the authors\* abandoned a diagnosis of this case as myositis ossif progressiva

CASE LXXXIX -Reported by Roberto Sole, in 1908 Female, aged 7 years Family history neg First symptoms appeared at 4 years of age-parents detected two cords in abdominal wall extending from thorax to pubes, and according to description of location were the recti muscles They felt hard to the touch two cords persisted in their hardness till child was 4 years old, when they gradually disappeared and abdomen grew normal Often fell in the first years of her life and at 21/2 years had severe fall, after which and since numerous hard tumors appeared, mostly on neck and thorax Suffered severe pains at 3 years These disappeared at 4 years, but tumors remained and increased in number and size Head bent forward and fixed firmly. In the ant region of the neck two stiff hard cords in the location and direction of the sternohyoids and mylohyoids, like rosaries on account of their interspersed osseous infiltrations along their course. A similar formation exists porteriorly on both sides of the cervical vertebral column, from the superior part of the thorax to the base of the occiput Thorax in kyphosis position, but not angular It shows numerous hard osseous tumors over the ribs, some intimately adherent to them, others simply on their borders Both pectorales major and latiss dorsi are ossified, keeping the arms in their rigid posture in the shoulder-joints Some few nodules of ossified tissue in triceps brachii. No mention of microdactylia, but in one of the photos of this case the presence of microdactylia of the big toes can be plainly seen

CASE XC—Reported by Warren Walker, in 1908 Female, aged 7 years Family history neg First symptom appeared at 6 years of age-stiffness of neck a swelling appeared in the right pectoral muscle and others in different parts of the body These swellings were painful to the touch Marked prominence of occipital tendon of right trapezius, muscle very hard and stands out like a cord and sternocleidi also involved, but not so extensively Head fixed on sternum, no rotation possible. At lower angle of left scapula exostosis one inch high, another one over minth rib just below the scapula is covered by a mass of indurated muscles Right scapula similar to left. Exostoses on eleventh and twelfth left ribs and several on left of lumbar spine in substance of erector spinæ Spinal column rigid Arms are held off trunk in abduction, cannot be brought to side of trunk humerus only movable with aid of scapula, over shaft a bony mass size of pigeon Motion of right arm also limited Bony masses in anterior and post axillary folds prevent motion Entire absence of thoracic respiratory movement abdominal muscles free Left thigh 175 cc larger than right Fingers are all

<sup>\*</sup>Fortschr auf d Geb d Rontgen Strahlen, bd 14, H 3

shorter than normal, little finger particularly so Hallux valgus and microdactylia of both big toes. The first metatarsal bones short and stubby and interphalangeal joints of big toes ankylosed

CASE XCI -Reported by Charles Adair Dighton, in 1908 Male, aged 11 years Family history neg First symptoms appeared between 4 and 5 years of agefollowing successive attacks of measles, bronchitis and whooping cough, complained of general malaise and weakness-most marked in legs, child unable to walk Subsequently muscles became stiff and hard, lumps formed in them, increasing steadily in size and numbers up to time of observation Weak and undergrown tender to touch Walks on balls of toes Lost almost all movements of shoulders Both arms show large bony nodules in biceps, triceps, coracobrachialis and elbows The biceps are almost completely converted into bone. Left arm shows greater development of osseous masses Forearm free, but muscles atrophied Extensors and flexors less affected In both legs adductors completely ossified Left leg more marked than right In the line of fibres of obliquus abd ext on either side where they run toward the pubic bone is an osseous plate the size of a man's hand No mention made of microdactylia Doctor Dighton kindly sent me his notes of the case, but no mention was made therein of presence or absence of microdactylia

CASE XCII - Reported by Charles F Painter and John D Clarke Male, aged 25 years Family history neg First symptom appeared at 6 years of age-torticollis, a symptom pronounced as hereditary in his family Numerous nodules developed all over the body in various parts and different articulations of spine and limbs became ankylosed. The right hip was mobilized operatively by removal of bone so that the joint could be freely moved after operation, but bony masses soon formed again. An open incision tenotomy of internal and external hamstrings was equally unsuccessful A hard mass on right side of chest A mass the size of a lemon situated under the left glenoid cavity. Motion of elbow limited nodes can be felt over arms, wrists and fingers near joints. On both sides of the spine over the fourth or fifth ribs are pronounced nodes, and similar ones occupy the right side of spine opposite sixth to eighth ribs Slight motion in atlanto-axoidean articulation, restricted by nodes No thoracic respiratory motion. Dorsal and lumbar spine completely ankylosed Left hip flexed about 40 degrees and adducted, with practically no motion Nodes on left tibia on the upper epiphysis, limiting both extension and flexion of knee Left ankle ankylosed, with nodes on dorsum and planta of metatarsus and phalanges The right quadriceps muscle and the hamstring tendons undergoing ossification along their entire length. Nodes on tibia similar to left Right foot similar to left The second toe of the left and second and third toes of the right foot are mentioned as being enlarged (The X-ray picture of the left foot shows microdactylia of big toe through smallness of metatarsal bone) This and a similar condition in the right foot may explain the elongation (?) of second and third toes

Case XCIII—Reported by G Rizzuto Female, aged 8 years First symptoms appeared at 4 years of age—in greater part of muscles of neck and nape of neck Later attacked sacrolumbar regions. Osseous hardenings in neck, lumbar region, scapula, thorax and arm Later affected the roots of right last ribs over the corresponding iliopsoas. Made hæmatological observations. (Only this brief, incomplete history as an account of the demonstration in the official report of the congress.)

CASE XCIV—Reported by H B Allen, in 1909 Male, aged 27 years Family history neg First symptoms appeared in early youth (?) Subsequent course of disease unknown Right temporal muscle partly ossified Plates of bone along main tendon of erector spinæ in dorsolumbar region and spreading in direction of supraspinous ligaments, serrati post inferior, and from lower ribs to inferior angle of scapulæ, uniting them both and sending off superficial process into ossified liga-

mentum nuchæ Left arm thickening of bone at inner bicipital ridge, at posterior Right arm thick buttress of bone in pectoralis edge of ulna and around wrist Beginning ossification in capsule of major from clayicle to outer bicipital ridge Osseous plates along shaft of humerus and process from upper part of Osseous hypertrophies at upper and lower ends of forearm olecranon thick buttress bone from ischium to femur, in line with quadrat fem Some osseous hypertrophies near insertion of glutæus maximus and upper part of adductor longus, osseous growth with knee-joint, causing ankylosis, also binding the heads of tibia and fibula similar growth at lower ends of bones Right leg bony ankylosis of hip-10int, with outgrowths from trochanter reaching tuberos ischii, and others from both trochanters to front of os pubis Lower ends of bone similar condition as Only photographs and skeleton available Microdactylia of both thumbs and big toes and ankylosis between some carpal and interphalangeal bones, ankylosed and deformed second and third toe-phalanges

Case XCV—Reported by L R Krever, in 1910 Female, aged 28 years Family history neg First symptoms appeared in twentieth year—very painful swellings on left shoulder, with light chilblains Subsequent course of disease unknown Ossification of pectorales, deltoid, supra- and infra-spinati muscles, trapezii, latiss dorsi, the lumbar muscles, fascia lumbodorsalis. No microdactylia mentioned

CASE XCVI—Reported by K F Person, in 1919 Male, aged 18 years Family history neg First symptoms appeared at 5 years of age-soft, painful tumors on sides of neck Tumors disappeared later, only to reappear in back of neck 13 years of age ossification of posterior muscles of neck, strongly involving ligam nuchæ, spinal and lumbar muscles, and erectores of left thigh Head slightly inclined backward and completely immovable Spinal column has slight scoliosis, is completely immovable in cervical and dorsal portions Slightly movable in lumbar por-Exostoses and hyperostoses on scapula, vertebræ and head of left fibula, sharp atrophy of muscles of back, scapula, pelvis, which have not become ossified movements of both shoulder-joints, especially right, of both knees, especially left, of both ankle-joints and of toes Scapulæ and ribs completely immovable, respiration abdominal Microdactylia of both big toes, with aplasia of phalanges, bilateral hallux valgus and bilateral partial syndactylism of second and third toes

CASE XCVII—Reported by G A Pirie, in 1910 Male, aged 6 years First symptoms appeared at 2 years of age-could not turn his head freely, had difficulty in moving it upward. Thickening and induration of ligamentum nuchæ Hardness gradually increased up and downward, and when child was 3 years old the new tissue felt as hard as bone and had extended and adhered to occiput This osseous growth was removed, and thereby the absence of spines and laminæ of third and fourth cervical vertebræ and defect in the closure of the spinal canal revealed, the spinal cord was exposed A few months after operation difficulty in raising his arms developed, and examination showed swellings and indurations in latiss dorsi muscles along both sides of vertebral column They gradually increased and spread until nearly all the muscles, tendons and ligamentous tissues over back of thorax have become ossified. Osseous formation on back of neck has been formed afresh and is adherent to vertebræ lower down A similar one is forming on left side. On right side osseous band extends from lower rib to crest of ilium A few bony nodules at inner sides of both tibix and slight induration of adjacent muscles Microdactylia of both thumbs

Case XCVIII—Reported by Alves de Faria, in 1910, and Jorge de Toledo Dodsworth, in 1912 Sex unknown First symptoms and age of their appearance unknown Subsequent course of disease unknown Entire report based on two radiographs I Taken in left profile osseous changes in superficial muscles of neck, after severe atrophic changes Osseous bridge from occipital protuberance to dorsal muscles

Between these and vertebral column some indefinite shadows, denoting second stage of invasion 2 Anterior view of thorax from seventh left intercostal space running toward humerus, but not reaching it, was a cross-formed osseous process. On right side a similar bridge joins the bone. From sixth rib a bony elongation runs to the outside and ends about middle of preceding one. The two are connected by a third one. Humerus thickened in upper part, numerous osseous nodules on back. Microdactylia not mentioned. No X-ray picture of hands or feet.

CASE XCIX -Reported by P J Stoyanoff, in 1912 Male, aged 25 years Family history neg First symptoms appeared at 10 years of age-when patient had variola Signs of former variola all over body Subsequent course of disease unknown Insertion genioglossus muscles ossified Neck rigid and moves with great difficulty Trapezu ossified and joined to scapulæ, which stands out wing-like Scaleni ossified The clavicles are bent, but muscles of the supra- and infra-spinous fossæ being Multiple exostoses, axillæ ossified Large portion of pectorales ossified Insertion of deltoids ossified, as also that of left triceps humeri Parts of biceps and coracobrachialis ossified Left elbow ankylosed at 180 degrees Moyable 15 to Spine ossified, vertebræ immovable Scoliosis toward left 150-160 degrees, in cervical region lordosis almost 90 degrees Musculature of back ossified and united to scapulæ Gluteal insertion ossified Left trochanter major has exostoses 7 cm in diameter Adductores femoris ossified and aponeurosis hard fasciæ hard Vastus intern on condylus intern ossified Right knee almost ankylosed at 90 degrees Exostoses in right popliteal region and in pes anserinus 4 cm long Triceps suræ hard as though ossified No microdactylia mentioned

Case C-Reported by Author R Elliot, in 1911 Female, aged 17 years Family history neg First symptoms appeared shortly after second year-lumps appeared on her head and disappeared again, no apparent cause, no injury In the succeeding three years more nodules formed At 5 years torticollis appeared and remained for about six months Later painful swellings on arms and legs interfered greatly with motion Since that time patient has never been able to abduct her arms or raise A valvular heart lesson was then discovered, no previous acute infection or rheumatism January, 1907, typhoid, July, 1907, stiffness of jaw, teeth could be separated but slightly, hard bony mass fills submaxillary region Hard circumscribed swellings free from ribs on both sides of thorax October, 1907, both arms became stiff and partial fibrous ankylosis developed in right elbow-joint. Left shoulder and arm followed Head bent forward and downward, stiff Maxillary movements much restricted Teeth separable only about one inch Lower jaw displaced to right side Anterior and posterior neck muscles firmly indurated Mastoid part of sternocleido of bony hardness, clavicular origin indurated Pectoral muscles hard and contracted Hard nodule on upper border of left scapula Small exostoses on right eighth and eleventh ribs, also ninth left, also on posterior crest of iliac Body bent forward, rotation of trunk impossible Spine firmly rigid either side of lower dorsal and lumbar spine a broad bony mass, over right inguinal region a firm induration size of a man's palm. Abdominal muscles tender to pressure Muscles of legs free, but patient states that they feel too short Both thumbs show bony ankylosis in terminal phalangeal joints Second joint pliable, but atrophic Thenar flat and atrophied Never had voluntary movements of thumbs They are held flexed on palms (pollex valgus) Microdactylia of both big toes, absence of one phalanx (?) Toes directed outward, lying partly under second toe (hallux No X-ray of toes Cause of short-hallux probably erroneous, and shortened metatarsus primus, here the usual explanation-X-ray of hands shows shortened metacarpus primus

Case CI—Reported by Jgn Peteri and Gust Singer Male, aged 4 years Family history neg First symptoms appeared at 1½ years of age—swellings on right and left sides of forehead They disappeared again after a few days Other

swellings appeared, which grew harder and finally became as hard as bone head bent forward and fixed rigidly, only slight lateral motion. A swelling size of a child's fist developed in submental region, during his hospital stay other inflammatory symptoms. With relief of these symptoms a solid mass remained, impeding movement of lower law Ridges of bony substance in temporal and masseter muscles Muscular part of nape forms a diffuse, solid bony mass with nodulated surface, causing rigid stiffness of neck Slender bony ridges in both sternocleidi bound to broader ones in deeper cervical muscles Pectorales major and minor changed to hard osseous plates The upper arms are firmly united to shoulder-blades and ribs by broad hard bridges, in anterior and posterior axillary folds biceps and brachialis ant contain broad bony ridges along entire length the right one is partially fixed to humerus, the left runs free from bone to tuberosit ulnæ Both scap fixed to back Musc of forearm tough and fibrous Entire vert column rigid The processi spinosi form, together with muscles and ligaments, thick, heavy, protuberating masses of bone tissue Four years later patient again admitted Stiffness and immobility of entire upper part of body Angular conformation of shoulder girdle and various relief-like elevations throughout body had increased, especially those of obliquis intern. Microdactylia of hoth thumbs and big toes (Synostosis between short first metatarsal bone and first phalanx)

Case CII—Reported by Felix Bauer, in 1911 Aged 2½ years Sex not mentioned or alluded to in entire paper Family history neg Scarlet fever when 6 months old (?) First symptom noticed was ossification of neck after scarlet fever Ossification of neck and shoulder progressed and caused decrease of movability of head and arms Strained, bent-forward posture of head and upper part of body Upper extremities fixed Spinal column stiff Sternocleidi and the deep neck muscles, the shoulder muscles and both bicipites are ossified and intersected with projecting lumps and spurs. They are mostly fixed to the underlying bones, only those of the biceps are free and movable in the muscles. From costal arch in anterior axillary line extends a round partly fibrous and partly osseous ridge size of penholder toward the symphysis. It continues upward toward the fifth rib on both sides. Over the shoulder-blades and at sides of spine several immovable, semiglobular, osseous tumors. Microdactylia of both big toes, in a lesser degree of both thumbs and little fingers

CASE CIII - Reported by Otto Jungling Male, aged 6 years First symptoms appeared before end of first year-lumps developed in nape of neck At first lumps disappeared again without leaving any traces, but after some time they recurred in the same place, remained and grew hard. Gradually this process spread from the neck to the back and arms, and for some time the upper part of the boy's body has been stiff Head, neck, shoulders and trunk quite stiff only be opened 134 cm. In the neck only the vert prominence can be felt, from it a bony ridge 4 cm long, thickness of a small finger, starts downward, divides into two and at level of scapula turns up again. At about the ninth vertebræ another ridge starts obliquely to the angle of the left scapula. On the right side only two The lumbar portion of the spine shows slight scoliosis convexity to right The sacrospinalis on the left is stone-hard in its entire length. A small bone plate in the height of the fifth lumbar vertebra. The upper arms are fixed to the thorax in an angle of 35 degrees From the scapula angles hard ridges run to both humeri In both triceps are hard bony masses and two stalactites in the right elbow head Both thumbs very small, due to smallness of first metacarpus The first and second phalanges of second and third fingers very small and ankylotic Shortness of right first, third and fourth and left first, fourth and fifth metatarsal bones The left first, fourth and fifth metatarsal bones show only minute epiphysial nuclei (distal) and the phalanges of all the toes are deficient. The first metacarpal metatarsal bones show

only proximal, the other second, third and fifth only distal epiphyses Hypospadiaurethral orifice at scrotal insertion

Case (?)—Reported by Riehl, in 1912 Male, age (?) No family history First symptoms appeared since 6 years of age—febrile attacks of pain in joints, with redness and swelling of skin. Later lime deposits in muscles and subcutaneous, tissue Skin difficult to fold, thickened in places, in others atrophic. Very little fat in subcutaneous tissue. Irregular and indistinct cloudy or striped shadows and very little pronounced ossification in X-ray picture. Author speaks himself of similarity of his description of this case with severe sclerodermia. (Not myositis ossif progress.) No mention of microdactylia.

CASE CIV—Reported by C A Manjapa, in 1912 Male, aged 25 years history neg Feverish illness at 6 or 7 years of age First symptoms appeared at 6 or 7 years of age-had, fever for nearly six months, and about that time lumps were discovered on back of neck and chest Grew gradually unable to stand erect or walk freely and became mentally deficient. His disease, on account of lumps, was erroneously diagnosed as leprosy and he was transferred to the leper asylum, later, in September, 1907, on account of his mental condition, to the lunatic asylum can only sit and stand in a crooked position. Head fixed, with deflection to left side. incomplete lockjaw, due to stiffness of masticating muscles Neck stiff and almost all voluntary muscles in slight or greater degree of ossification erectores spinæ present, bony ridges extending from suboccipital to lumbar region and bony tumors at spine and inferior angle of right scapula. Left pectoralis major hard, bony ridges along sternal fibres, connecting with one from their humeral insertion Right deltoid also shows bony ridges Right forearm fixed at right angles to arm by bony buttresses Left forearm fairly movable, but not to full extension supinator longus entirely ossified and bony swellings in flexors and extensors of left Left thigh has movable bony plates in region of extensor quadriceps, adductor longus and hamstring muscles Had short fingers and short toes eight months prior to his death (July, 1910), from dysentery, patient began to lose flesh and strength The joints became more firmly fixed and the osseous growths very prominent and distinct

Case CV—Reported by Fritz Magyar, in 1912 Female, aged 3 years and 9 months Family history neg First symptoms appeared at 3 years—hindrance in motion of muscles of upper arm and pains on pressure Pains disappeared, but hindrance remained and muscles grew stone-hard Head bent forward Ossification of both bicipites brachii, on back also ossifications in serrated form adhering to underlying tissues. The movements of arms were interfered with by hardening of upper and lower margins of latiss dorsi posteriorly and pectorales major anteriorly. No mention made of microdactylia (Brief notes only in Wien mediz Wochenschr) To personal letter received no reply

CASE CVI—Reported by David Rankin, in 1912 Female, a little negro girl Subsequent course of disease unknown Casual observation of author during visit to a hospital in Brazil, where he saw a little black girl suffering from myositis ossificans progressiva, with trapezius, latiss dorsi and greater portion of both pectorales ossified No mention made of microdactylia

Case CVII—Reported by Joseph Frattin Female, aged 14 years Family history neg First symptoms appeared at 1½ years of age—painful swelling at nape of neck, diasppeared again within twenty days without leaving a trace. At 4 years painful swelling again developed in same place and disappeared again, but neck remained stiff, later back and hip, which likewise showed exceedingly hard tumors. She suffered from epilepsy at an early age. The attacks grew rarer, and two months after leaving hospital disappeared entirely. Head slightly inclined toward right, can be turned, but not freely moved from side to side. Hard nodules on both sides of glabella, some adherent to bone. Muscles on both sides of nape of neck have bony-

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hard nuclei at occipital insertion, the right sternocleido at mastoid and a bony thickening at clayicular Lower insertion of scaleni ossified Upper margin of cucullaris and upper part of left sternocleido ossified Tendon changed to osseous band Both arms fixed in adduction In right biceps and triceps, pectorales, latiss dorsi, many bony plates, on left side tendons of these muscles ossified, on lower epiphyses of humerus irregular bony mass encircling joint completely Breathing abdominal Broad muscles of back completely ossified, left more so than right Infraspinatús and sacrolumbalis show osseous plates movable in muscular tissue. Near sacroiliac symphysis are osseous tumors, both hips stiffened, soft parts surrounding coxofemoral toints show many ossifications At lower part of glutæus major large osseous band and an osteoma on inner side of crista ilii Similar conditions on left leg Head, slightly inclined toward right, can be turned but not freely moved from Both big toes show microdactylia Left smaller than right side to side nicture not quite clear

CASE CVIII—Reported by S Goto, in 1912 Male Family history neg First symptoms appeared at 1 year and 10 months of age-swelling and hardening in jugular fossa Later an osseous formation developed in the jugular swelling A year afterward swellings on occiput and various other parts of the head, which disappeared again Since January, 1911, parents have noticed stiff posture of body Weight, 14525 kils, height, 930 cm Movements of head very limited From posterior surface of mandibula comes a hard osseous band to posterior surface of chin Small tumors at sternal origin of sternocleido and at insertion of trapezius Both scapulæ fixed to thorax and their lower angles are united in one solid mass with surrounding ossified tissues On both sides of sixth to eighth dorsal vertebræ bony growths size of thumb Along both sides of spine broad, symmetrical, flat, bony growths 3 cm broad, united below to crista ilii, above to masses at sides of vertebræ The ant and post axillary folds are ossified. Arms only very slightly movable in shoulder-joints, free in elbow and other joints. A string-like band in right side of abdomen and a small, hard, osseous thickening on inner condyles of femur and tibia Both thumbs and big toes abnormally small, owing to smallness of metacarpal and (Hallux valgus) Electrical sensibility, decrease to absence of metatarsal bones irritability to faradic or galvanic current in affected muscles. Those apparently free from affection show no disturbance

CASE CIX—Reported by Rudolph Jacobi Male, aged 6 years Family history neg First symptoms appeared at 3 years of age—hard nodules formed on back Nodules were rather flat at first, but grew gradually to their present size For the last five weeks there has been a disturbance of the free motion of his right arm. Movements of head not free, chin cannot be brought to thorax Scattered over entire back are numerous osseous protuberances of semiglobulous and flat form, averaging pigeon-egg size, also long ridge or beam-like elevations of about 15 cm length and thickness of thumb diverging from median line to lateral parts of thorax Nearly all the muscles of the back are changed into a hard osseous mass, encasing the ribs armor-like and inseparably connected with them Respiration abdominal, thorax shows only minimal excursion Arms and legs show no change except exostoses on both condyli interni tibiæ, 2 cm long Microdactylia of thumbs and big toes (Hallux valgus)

Case CX—Reported by S J Khaikis, in 1913 Male, aged 4 years Family history neg First symptoms appeared when about 3 years of age—old swellings appeared on occiput. Later swellings showed on back and lower extremities (treated by local physicians with inunctions), they would subside, then reappear These tumors began to appear first on the occipital musculature, then on that of the back and upper ribs The swellings along the ribs were quickly absorbed, but the others hardened and had the consistency of bone Patient only complained when new swellings appeared Boy normally developed Pain when bent over, but head can be bent

#### MYOSITIS OSSIFICANS PROGRESSIVA

forcibly in the different directions without pain Occipital movements interfered with by tubercles on occipital bone about attachment of cucullaris Similar tubercles on both sides of spine along lower third dorsal and first lumbar vertebræ Other nodules appear over middle of upper ribs, also in axillæ, interfering with raising of arms During observation of one month methodical treatment with potassium iodide, baths and fibrolysin Condition grew worse, redness and swelling to left side of second lumbar vertebræ Redness disappeared again, but swelling grew osseous No mention of microdactylia

CASE CXI—Reported by Volhyma Medical Soc, 1913 Female (?) Subsequent course of disease unknown The foregoing case was before his discharge shown in the Volhymia Medical Society A similar case of a girl was demonstrated there also Demonstrator not mentioned in report

CASE CXII—Reported by Erich Blenkle, in 1914 Male, aged 21 years Not much known about early history, lost parents very early in life Subsequent course of disease unknown Stature of boy 10 to 12 years, height, 137 cm, panniculus underdeveloped. All the limbs except the right leg and hand stiff, cannot sit down, has to do his work, eat, etc, standing Jaws cannot be opened more than 1/2 cm Teeth (incisors) have been removed for feeding Masseters hard, with hard osseous nodules imbedded only movable sideways in very slight degree Spine completely stiffened cleido and neighboring muscles of neck, entire musculature of back stiff and hard and interspersed with small osseous nodules. Along entire dorsal spine large osseous plates, below tenth and eleventh vertebræ no muscles to be felt, only one continuous osseous plate, extending to crista ossis ilii Thorax and ribs immovable, breathing Pectorales and deltoids stiff and hard Both arms fixed, left entirely abdominal Osseous imbeddings in biceps and triceps and near origin of extensor carpi radialis Slight volar flexion possible in left wrist Both hip-joints immovable, hard masses surround both trochanters, knee-joints slightly movable, osseous plates Exostoses of femur, hard mass around left knee muscles of in left adductor right leg, around hip and knee-joint hard and stiff Both thumbs small (microdactylia). Third phalanges of fourth and fifth fingers turned toward radial side No microdactylia in either foot

Case CXIII—Reported by F Parkes Weber and Alwyn Compton, in 1915 Female, aged 21/2 years Family history neg First symptoms appeared at 71/2 months of age (March, 1913)—was shown before the Royal Society of Medicine, with bony projection from left side of neck and thin spicula of bone attached to middle of the back of left clavicle In March, 1914, various diffuse swellings appeared, involving muscles and superficial fasciæ, skin could be freely moved over them They disappeared and soon were followed by others in left scapular region and left lower part of Similar ones appeared also on right side In May, 1914, a distinct bony formation appeared in left posterior axillary fold, and transient swelling in right In June hard swellings in right biceps and lower part right scapula and corresponding ones on left side In September and October a bony lump on occipital insertion of trapezius. Very stiff in movements of back and neck, extension grows more and more limited There also seems to be osseous infiltration in both anterior and posterior axillary folds, limiting abduction of both arms Microdactylia of both thumbs and big toes, in the thumbs due to smallness of the first metacarpal bones, in the toes to a synostosis and resultant smallness of phalangeal bones valgus) A small piece of right latiss dorsi examined microscopically showed invasion of muscle by newly formed fibrocellular connective tissue

Case CXIV—Reported by Angel M Centeno Male, aged 8½ years Family history neg At 3½ years phlegmonous (?) inflammation of left sternocleido First symptoms appeared at 6 years of age—entered Children's Hospital Smooth, hard, painless tumors in region of right scapula (Caught measles in hospital, but recovered

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without complications) When seven months in hospital first operation was performed on sternocleido tumors Result not known to padres Later new, round, hard, painless tumors of various sizes appeared over the entire region of the dorsalis major, the trapezius and the costal walls Shortly after the first operation a second one was performed, and a little later a third one, for the avowed purpose of removing little pieces of new-formed bones Wassermann positive (Author seems to attach much etiological importance to this reaction, in other such cases reaction was negative) Face looks as if patient has adenoids and prognathism of left maxillary bone inclined forward and downward. The physiological lordosis has disappeared. Thorax slightly inclined forward, arms fixed in the same direction as upper part of thorax, separated from it and in attitude to grasp an object Osseous tumors in dorsalis longus, trapezius and both sacrolumbales, in fact, entire posterior wall of trunk In upper movement of left trapezius a perfectly movable, painless, small, hard nodule Lower extremities slightly flexed, left forming an obtuse angle with thighs hallux valgus turned outward and metatarsophalangeal at nearly right angles with first metatarsal bone, covering with the lateral edge of the phalanges the second metatarsophalangeal articulation There is a disturbance in the development of the two upper and inner incisors. They show an excrescence, which descends to the point of an implantation from the inner side to the middle of the teeth rows of teeth do not meet together, and in the hard palate is a deep oval impression The voluntary motions are limited by the described lesions Left arm passes with difficulty just the horizontal line, right one appears as if glued to the side, its angle of motion not more than 30 degrees Hands show thinness of little fingers and shortness of thumbs at expense of last phalanx (?) No X-ray of either hands or Both testicles are ectopic, having remained in the inguinal canal near the external opening Nothing else of note

CASE CXV—Reported by Seth Hirsch and Joseph Roth, in 1917 Family history neg First symptoms appeared at 2 years of age-lump on right side of neck Lumps on neck disappeared Other lumps developed below right scapula Said in orthopedic hospital he had suffered from tuberculosis, applied a brace for nine months It was then removed Incision was made upon lump below right scapula During last year the shoulders were becoming progressively displaced forward Tonsils and adenoids were removed a year ago Slimly built, walks about, but is constrained in movements of back and arms, shoulders very narrow, as though cramped forward Calvarium shows at right parietal region large soft tumor about two inches in diameter, seemingly set into the bone. Both scapulæ are tilted forward and seem to be fixed in relation to the ribs. A bony protuberance below right scapula Some pain at movements of shoulder beyond difficult limitations Very rigid spine throughout (Pokerback) Normal genitals Shortenings of both thumbs and big X-ray shows below the angle of the left scapula a large, rounded bony mass. and extending upward and inward a strip of bone located in the teres major. At the right side a large bony mass posteriorly behind the tenth and eleventh ribs, extending upward and outward into a rib-shaped prolongation, bounding the inferior axillary space and divides near the humerus into two small branches. This entire ossification is in the latissimus dorsi In the right lumbar region opposite third and fourth lumbar vertebræ is an irregular stellate ossific shadow, and extending upward a linear mass merging with the body of the twelfth dorsal. On the left side runs an ossification strand from the lower ribs toward the iliac crest. Knees show a spur-like, bony formation from the posterior surface of the lower and of the left femur diaphysis Also small ossification strand above its head Thumbs and big toes show brachydactvlia

Case CXVI—Reported by Seth Hirsch and Joseph Roth, in April, 1917 Family history neg First symptoms appeared at 6 months of age—small nodule on forehead, increasing in size to that of a plum, then remained stationary Well after lump on

#### MYOSITIS OSSIFICANS PROGRESSIVA

forehead till age of 8 years, when it was noticed that he could only raise the right arm with great difficulty Soon after the left became similarly affected was removed to post-graduate hospital, where incisions were made over both scapulæ and pieces of a bony growth removed Child got scarlet fever, returned Conditions progressed slowly, involving neck and rest of the spine the lower extremities became also involved, boy still being able to walk with some difficulty The disease shows signs of progression Patient very thin, mentally active, able to walk with difficulty Spine rigid and kyphotic, neck rigid, arms are adducted, he is unable to move them either outward or upward. Scars over both scapulæ from which portions of the osseous growth have been removed. There is a bony growth about the left frontal bone The posterior muscles of the neck appear hard to the The scapulæ are markedly winged The upper extremities are fixed to the axillary border of the thorax There are hard bony masses running from the serratus magnus on each side to the humerus Posterior spinal muscles appear hard, there is marked rigidity of entire spine. There is marked contraction of the adductors and the tensores fasciæ latæ The thighs are flexed on the pelvis, fixed and adducted, the legs are flexed on the thighs. Hard bony masses in the adductors and muscles of the calves The genitals are normal The big toes are considerably X-ray examination Numerous strands of ossification in both latissimi dorsi and in many of the intercostal muscles of both sides Examination of the pelvis shows numerous branch-like strands of ossification extending into the left gluteal group A large spur-like mass, of bone between the lesser troclianter and the right ischium. The knee shows a long spicule of bone springing from the posterior surface of the femur Both big toes show brachydactylphalangia

CASE CXVII - Reported by Eug L Opie, in May, 1917 Male, aged 70 years Nothing mentioned of previous history, description of skeleton only given Subsequent course of disease unknown Left internal pterygoid muscle ossified edges and articular surfaces of the cervical and lumbar vertebræ show bony projections Head and neck of seventh and eighth ribs ankylosed by bony union with the corresponding vertebræ Broad bands about 2 cm across connect on the right side of the fifth, sixth and seventh ribs about 25 cm from their vertebral origin, the fourth and fifth ribs are similarly united on the left side. The bones of the shoulders and upper extremities show prominent ridges for the insertion of the muscles No deformity of hand Pelvis shows similar prominences and projections also on edges of acetabulum. Both femora show irregular ridge of bone I cm high on the linea aspera just below the middle of shaft Tibiæ and fibulæ very irregular in outlines Rough areas with spiculæ project upward in the direction of the muscles Bones are considerably thickened by periostitis, membranæ interossei are ossified at irregular places, forming ridges of bone Right foot porous texture of bones Distal end of first metatarsal is enlarged and irregular in contour Projecting downward and backward from the head of bone is irregular osteophyte I cm long Small bony projection, 3 cm long and ankylosed, at the upper inner surface of the articular surface representing the two terminal phalanges of These bones do not extend beyond the first interphalangeal point of the great toe second toe Left foot shows some porous texture of bones Head of first metatarsal bone absent, end of bone broadened Appearance of metatarsal bone as if its head, together with big toe, has been amputated Microdactylia of both big toes (?)

CASE CXVIII—Reported by Ten Bokkel Hunnk, in June, 1917 Female, aged 7 years Family history neg First symptoms appeared at 2½ years of age—swelling under chin Swelling under chin disappeared, was followed by one in neck, causing stiffness Had hard nodules on forehead, which also disappeared later Mouth can only be opened 34 cm Flexion in elbow-joint to 90 degrees, extension to 120 degrees Left shoulder hardly movable Along the upper ribs many bone-hard swellings The lower third of the left m biceps feels like a bone-hard mass. The left axilla is entirely enclosed with bone-hard plates, no muscle to be felt. The muscles of the

#### **JULIUS ROSENSTIRN**

neck, with the exception of the sternocleidomastoidei, are changed to a bone-hard mass. Large bone-hard plates in the long muscles of the back, also in the left latissimus dors. The medial edge of the right scapula merges into a bone-hard mass, which is fixed to the boneplates in the long extensor muscles of the back. Returned later with about the same status, only that the mouth can be opened wider and the muscles of the neck, which felt like a bone-hard mass at the first examination, now have grown softer, and though not as soft as ordinary muscles, no bone-hardness can be felt in them, and the movability of the head is accordingly improved. X-ray plates not shown in this publication, but author mentions that only in the chest and back the palpatory findings are confirmed by the X-ray, while the neck muscles show no ossification and the biceps show only a very small piece of bone in the muscular tissue. Bilateral microdactylia of both big and little toes, big toes have large first metatarsus and only one very small phalanx. (Synostoses?) Little toes very small phalanges.

CASE CXIX -Reported by C Johannesen, in 1917 Female, aged 2 years and 8 months Family history neg First symptoms appeared at 1 year and 8 months of age-swelling over skull and occiput (Protub occip) Swellings were not sensitive After four months later swelling over left shoulder, spreading to left scapular region and left side of neck to ear. It traveled in four to five days under left arm and across back. Not sensitive, no discoloration of skin. Arms could hardly be moved After a week swellings began to disappear, instead a swelling in shoulder-joints appeared in left sternocleidomastoideus. After the left-sided swellings had disappeared swellings showed in right scapular region under right arm and lumbar region About two weeks ago patient became sick, had chills, took to her bed and has lost flesh Patient well developed Height 885 cm, weight 138 kg Head circumference 52, chest 54 cm, anæmic, purulent discharge from both ears, nasal discharge and cough, chest and abdomen normal, temp 37.2, pulse 92, regular, sits rigid, bends head forward and over to right side, with face toward left, opens mouth wide and masticates and swallows without difficulty, right side of neck and right fossa supraclavicularis are swollen, swelling of lower half of sternocleido inspection of right side of back shows swellings and grooves like topographic chart Swellings in the neck in fossa supraclavic continue over right part of back down to eleventh rib Swellings in muscles of trapezius, axillary folds and serratus ant They reach middle axillary line from second rib down to eighth rib Swellings are bonehard and immovable over underlying tissue Skin normal appearance stiff, left can be moved freely Wassermann and v Pirquet neg Erythrocytes. 6,000,000 Leucocytes, 125,000 Urine nothing abnormal Microdactylia of both thumbs and big toes Hallux valgus bilateralis. According to Roentgen plates the thumbs show a shortened first metacarpus and both big toes a synostosis of a shortened first metatarsus, and first phalanx with a separate small last phalanx outward, resulting in bilateral hallux valgus

CASE CXX—Author's own case, in 1916 Male, aged 20 years First symptoms congenital Subsequent course of disease reported elsewhere in this text. Status at time of observation reported elsewhere in this text. Congenital abnormalities reported elsewhere in this text.

(TO BE CONTINUED)



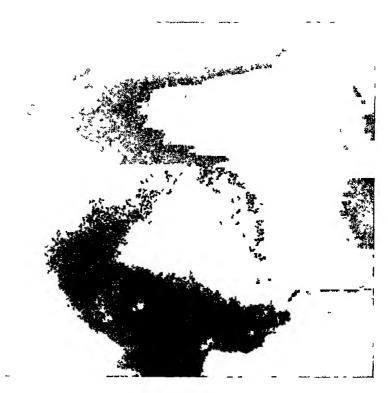
Fig. 1 —Mrs. M. No history of injury. Died from pulmonary lesion



Γις 2 -Mrs J \o history of injury



Fig. 3 —Mr. R. Injured nine years ago. Died from cerebral hemorrhage



Γισ 4 -Mr McM Injury twenty seven years ago

# A RADIOLUCENT SEMILUNAR SHADOW OCCURRING AS A CONSTANT FACTOR IN CERTAIN CASES OF SEVERE INTERMITTENT HEADACHE

PRELIMINARY REPORT

By A MERRILL MILLER, M.D.

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AND

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DIAGNOSTICIAN IN CHARGE OF LAKE VIEW HOSPITAL LABORATORIES

Early in April of 1918 our attention was attracted to a shadow which was found on the skull plates of patients who were examined for possible cause of severe intermittent headaches. On single plates the shadow is semilunar in shape and lies immediately below the cranial vault. In stereoscopic plates it has the shape of an evaporating dish with one edge across the median line. Some cases show it on the left side and others on the right. At first it was thought to be an artifact or plate fault, but was found to be constant in all of the cases examined regardless of the position of the patient, tube or plate. Postero-anterior views of some of the cases show it corresponding in size and position with the findings of the lateral stereoscopic plates.

The cases which have shown this shadow give parallel histories. All have entered the hospital for the relief of severe intermittent headaches, which do not respond to the usual methods of treatment. The four cases which we present were all adults in middle life. Two of them were males, giving history of remote head injury, one of them nine years and the other twenty-seven years previous to entry to the hospital. Of the two females, neither had history of injury. One was decidedly neurotic. All cases were free from gross anatomical disease or lesion. One male showed marked change in disposition, being considered by his family as dangerous on account of violent attacks of angen from trivial causes. This is the only suggestion of mental instability shown by any of the cases.

Since this study was started two deaths have occurred. One male, who was injured nine years ago, died from cerebral hemorrhage, and one female from a pulmonary lesion

As a cause for the appearance of this semilunar shadow as a constant factor in these cases, we offer the hypothesis that it is due to hydrostatic changes in the cerebrospinal cavity. What this change is we are not prepared to say, as this is a clinical rather than an experimental study. It is our feeling, however, that a study of intraspinal pressure in these and similar cases will illuminate the field

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#### IMPORTANT POINTS RELATING TO THE SURGICAL TREAT-MENT OF PROSTATIC HYPERTROPHY

# By Albert J Ochsner, M D of Chicago

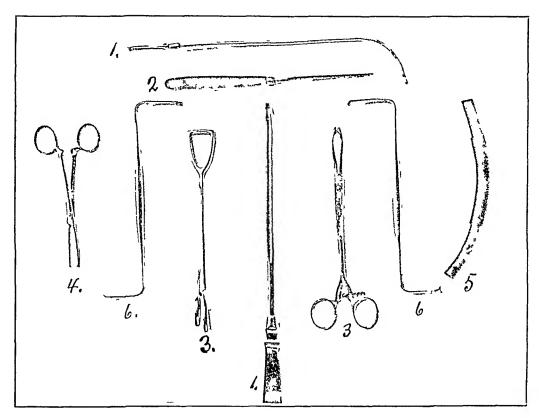
ALTHOUGH it is practically impossible to determine the number of deaths attributable directly to hypertrophy of the prostate gland, it is a well-known fact that the number is enormous. A large proportion of these cases are classed under pyelitis, chronic nephritis, uræmia and pneumonia because these are the terminal conditions, which would, however, not have occurred except for the effects of the obstruction due to the prostatic hypertrophy with its secondary conditions

All of these secondary conditions are due to a simple mechanical obstruction, and the question arises, Why is this obstruction permitted to continue? The diagnosis is easily made, the discomfort of the patient is sufficient to cause him to seek the physician's advice, and the prognosis without relief is sufficiently grave to warrant radical treatment

Why is such treatment not an almost universal practice? There are a number of potent reasons. First, patients at the age at which this condition becomes troublesome are, as a rule, not good surgical risks, consequently, the surgeon's reputation is likely to suffer if he undertakes these operations readily. The elements of risk come, first, from shock, second, uræmia, third, loss of blood, fourth, anæsthesia, fifth, post-operative pneumonia, and, sixth, sepsis. Aside from this risk there is also the discomfort from post-operative conditions, such as the long-continued drainage and incontinence of urine.

All of these conditions can, however, be greatly modified, if not eliminated also completely, if the method of treatment about to be described is carefully followed

The shock in these patients seems to be due to exposure to long-continued operation, rough manipulation, and loss of blood. After the introduction of the suprapubic method by Freyer, which reduces the time of operation to a fraction of the time consumed formerly, the element of shock was eliminated to a marked extent. This element is still further reduced by the operation about to be described. The danger from loss of blood has been reduced by proper tamponing, that of post-operative uramia, by irrigation of the bladder continued for a period previous to the operation, and by preliminary suprapubic drainage. The danger from anæsthesia has been reduced by reducing the time of operation, by giving the patient a proper hypodermic dose of morphine and atropine previous to giving the anæsthetic, if general anæsthesia is used, and by the use of spinal anæsthesia. The same plan of treatment and placing the patient with the head of the bed elevated



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#### TREATMENT OF PROSTATIC HYPERTROPHY

from 12 to 18 inches immediately after the operation, and having the patient accustomed to lying in bed before the operation, reduces the danger from pneumonia. All of these methods together with the method of operation have practically eliminated the danger from sepsis, because the trauma is reduced to a minimum and the drainage is ideal

There is no doubt but what in the hands of expert operators any one of the operations that have been described during the last few years will result in a recovery in a very high percentage of patients, and that by applying these operations regularly in all cases suffering from obstruction many years could be added to the lives of men who now die directly or indirectly as a result of prostatic hypertrophy

The method to be described contains all of the advantages of all of the various methods with a less number of disadvantages. It consists in the following steps

The patient is properly prepared by vesical irrigations continued for some days or even weeks before the operation is to be performed. The urine is disinfected by the administration of urotropin, five grains dissolved in a glass of water and given every three hours has usually been found sufficient. In cases that are not suitable for any considerable operation, even after the above preparation, suprapubic drainage should be employed for several weeks previous to the removal of the prostate

Steps of the Operation — The patient is given a hypodermic of one-quarter  $(\frac{1}{4})$  of a grain of morphine and one-hundredth  $(\frac{1}{100})$  of a grain of atropine, half an hour before the ether is administered by the drop method

Everything is in readiness so that no time whatever is lost from the beginning of the anæsthesia to the end of the operation

The bladder is irrigated with permanganate of potash solution, and a sufficient amount is left in the bladder to cause it to be moderately distended but not sufficient to cause a possible rupture

The patient is then placed in the lithotomy position and after dilating the sphincter ani muscle a grooved sound (Fig. 1) is introduced into the urethra down to the perineum

An incision is then made corresponding to the lateral incision formerly practised in the operation of perineal lithotomy, extending from a point half-way between the scrotum and anus to a point half-way between the left tuber ischii and the anus, and extending down into the membranous urethra which is opened at this point sufficiently to admit the point of an old-fashioned lithotomy knife (Fig 2)

The sound together with the lithotomy knife are then passed into the bladder, care being taken to carry the sound along the pubic bone in order to prevent the knife from cutting into the rectum, thus splitting the membranous and the prostatic uiethra posteriorly

The knife is then withdrawn, and the operator's finger is carried through the incision along the sound into the bladder

The finger is now precisely in the same position in which it would be if a

#### ALBERT J OCHSNER

suprapubic opening had been made, and in this fact lies the important advantage of this over other methods of operation, because beginning from above and entering the capsule of the prostate gland through the urethra one is in a position to enucleate the prostate precisely as though the bladder were entered from above and through the usual suprapubic incision, and one were to enucleate the prostate gland according to the Freyer method

This step of the operation should be carried out with the utmost care in order not to disturb the bladder or urethra unduly. If bands of adhesions are encountered, a pair of blunt curved scissors should be carried along the finger and these bands should be cut. Presently the entire gland is free from its attachments to the urethra, and the capsule and gland are withdrawn through the perineal incision by means of Dr. Hugh Young's forceps (Fig. 3). The area is then carefully explored with the finger and occasionally an additional lobule of prostatic tissue is found which has to be enucleated.

The index finger of the left hand is then introduced into the neck of the bladder, and the capsule of the prostate is caught by means of a fine-tooth forceps (Fig 4), one being applied to the right and one to the left, and a drainage tube consisting of an inner tube i cm in diameter covered in its middle portion by a second rubber drainage tube just large enough to slip over the first one (Fig 5) is introduced into the bladder, the inner tube extending into the bladder, and the outer tube into the capsule

Ferguson's retractors (Fig 6) are then applied to each side. The capsule is held in position by means of the fine-tooth forceps, the gauze is packed around the rubber tube into the capsule. The double tube prevents collapse, and offers a sufficient amount of resistance to make the tamponing effective for controlling the hemorrhage.

The rubber tube is held in place by means of silkworm-gut sutures which pass through the edge of the wound and the outer rubber tube

Two days after the operation the tube and packing are removed Occasionally, one encounters a prostate gland which is hard and fibrous and cannot be enucleated. In this case it is removed by gnawing away piecemeal under guidance of the finger by means of the Ferguson gnawing forceps

The entire operation can usually be performed in less than fifteen minutes. The shock is minimal, the amount of traumatism is not extensive, and drainage is downward through the perineum in the most comfortable and most effective position

After the removal of the drainage tube and tampon the patient can sit up. After the fifth day the patient can take daily tub baths and within two weeks the urine usually begins to pass normally

I am convinced that no one who has tried this method will hesitate to relieve these patients by operative treatment

The use of the grooved sound and the old-fashioned lithotomy knife, the method of attack from above, and the method of drainage and the placing the tampon are the special features

#### TREATMENT OF PROSTATIC HYPERTROPHY

The older surgeons who have practised perineal lithotomy before crushing of stones and suprapubic lithotomy had displaced this method can appreciate the ease and safety of this method and the value of the grooved sound and the old-fashioned lithotomy knife with its blunt point and its cutting shoulder, which will cut the posterior wall of the membranous and prostatic urethra without injuring other tissues

The bladder being open, the next important step consists in carrying the finger into the bladder and working from above downward, precisely as though one were performing a suprapubic prostatectomy

The anæsthesia can be discontinued after the first incision has been made because the operation will be completed before the patient realizes any pain A very small amount of ether is required for this operation

The operation can be performed with great ease under spinal anæsthesia. It is well to dilate the sphincter ani muscle before beginning the operation in order to increase the comfort of the patient during the few days directly following the operation

The after-treatment consists in the administration of an abundance of distilled water and the giving of light diet

The tube and tampon are removed after two days and the patient is permitted to get out of bed. After the fifth day he is given daily tub baths also an ounce of mineral oil at bedtime

In case there is a tendency to the accumulation of phosphates in the wound, the patient is given two or three drops of dilute hydrochloric acid in half a pint of distilled water every hour until the phosphates disappear

The post-operative course of these cases and the results are as uneventful and satisfactory as were these conditions in the perineal lithotomies

#### THE AMBULANCE AIRSHIP\*

A FACTOR MAKING FOR IMPROVED ARTICULATION BETWEEN THE MEDICAL DEPARTMENT AND THE FLYING OFFICE

#### By NORVELLE WALLACE SHARPE, MD

OF ST LOUIS, MO

Quite independent of questions of humanitarianism and philanthropy, it is obvious that the rescue of the wounded, and their reclamation back to vigorous efficiency, is a wartime problem of prime importance. The modern army, divorced from its medical department and the usual activities compassed by a medical department, will degenerate, ab initio, into a defeated mob. It may be freely observed that salvaging the sick and wounded of the long established branches of the service offers problems that differ somewhat in types, but no basic differentiation is to be noted

By contrast, however, not the least among sundry problems presented by, and peculiar to, the specialized air service is the most efficacious method of handling wounded flying officers. For the purpose of this article, reference is made, not to the surgical problems engendered by the air service, but rather to the procurement and transportation of the individual

No special difficulty is encountered following casualties upon, or within the vicinity of, the flying field, particularly if the terrain be such that ambulances may be operated with reasonable ease. Difficulties multiply, however, when casualties occur remote from field or hospital, and upon a terrain difficult of access, or otherwise requiring an unreasonable loss of time. Nor should the fact be overlooked that airship casualties frequently include injuries to the cranium, vertebral column, thorax, abdomen (and those of the gravest type)

To meet the situation there has been developed a somewhat anomalous articulation between the flying office and the medical department. The former merely notifies the medical department of any accident (of which it may be cognizant) that occurs remote from the field, the latter cooperates by maintaining on the field a medical officer, with enlisted men of the medical detachment, an ambulance equipped with first-aid material, simple splints, dressings, are, bolt cutter, and saw, and, in addition, holds itself subject to call, both day and night, for accidents that obtain remote from the field. It

<sup>\*</sup>It may seem strange that a surgeon should attempt to solve a problem that would more naturally fall to the consideration of the Engineers of the Air Service, but to my mind the crux of the problem is a wounded man. Hence I have attempted its solution. In like manner it may seem strange to submit such an article to a surgical journal for publication, but I take it for granted that you would be glad to cooperate toward making successful a plan for salvaging wounded men—Norvelle W. Sharpe

#### THE AMBULANCE AIRSHIP

is but reciting a well known fact that such accidents (particularly in cross-country flights) may and do occur many miles distant, and, not infrequently, the ship and its occupants are so successfully obscured by their environment that discovery is a matter tedious of accomplishment, and entailing an enormous wastage of time and effort, together with an unavoidable prolongation of suffering and shock to the fallen and wounded aviator

It is obvious that this articulation of the flying office with the medical department has superimposed upon the latter a burden of responsibility disproportionately onerous. But it is to be noted that the medical department, in accord with its honorable traditions, has cooperated faithfully and efficiently

The following points are stressed

The usual ambulance equipment and service are inadequate for this specialized problem,

The medical department thereby works under a handicap,

Valuable time is lost, and needless suffering and shock (to the fallen and wounded aviator) accrue

The most satisfactory solution would seem to lie in an improvement of ambulance equipment and ambulance service, and an appropriate assumption by the flying office of a task hitherto carried by the medical department. In a word, the usual motor ambulance of the medical department should be replaced by an ambulance ship under the control of the flying office.

It is obvious that the ambulance ship would not be restrained by the handicap inherent to motor ambulances, and that the flying office should control the aerial ambulance devoted largely, if not wholly, to search for, and salvaging of, the wounded aviator

I assume that this problem has presented itself to other minds, and that the ambulance ship, as a possible solution, has received consideration. In fact, I have studied one specimen built at Gerstner Field during the period when I was in charge of the Gerstner surgical service, but I am unaware, either from personal observation or the opinions expressed by medical, flying, or engineering, officers that the original problem (of the ambulance ship as a solution) has been satisfactorily settled <sup>1</sup>

Of interest in this connection is the following notation sent me by Lieutenant Colonel Garrison, Acting Librarian, Library, Surgeon General's Office "Replying to your letter of August 6, relative to ambulance airships, I regret to inform you that this office has nothing of this sort on file \* \* \* we are unable to comply with your request and furnish you with such literature" Under ordinary circumstances one would assume that the dictum of the Librarian of the Surgeon General's Office would be the "last word" But, oddly enough, it chanced that while dictating these notes to a stenographer I was informed by a "trouble-shooter" that in England last year he had seen an ambulance built from a Livermore-Sunbeam-Coatelien, and that a memorandum concerning same had recently appeared in *Popular Mechanics* Search in the Sacramento Library, through issues of 1918, proved fruitless, but a note in *Scientific American*, November 24, 1917, briefly recorded some experimental work of the French, conducted at the Villacoublay Aerodrome, with an aeroplane ambulance

#### NORVELLE WALLACE SHARPE

As a contribution toward such solution, I submit the accompanying drawings of an ambulance ship (Figs 1 and 2)

In contradistinction to any ship so built that the patient is compelled to sit in a more or less erect posture, this ambulance has been designed primarily for the welfare of the patient, his personal comfort, and his personal safety. It will be observed that no alteration of the stream-line fuselage has been made, nor alteration of the fuselage that would involve a structural weakening, that the requisite alterations are simple in design, inexpensive in material and labor, and well within the capability of the shop personnel of the flying field. The proposed ambulance ship may be built at the factory—but, equally well, may be constructed from a JN4D airplane in the shops of any properly equipped flying field.

The instrument board of the forward cockpit has been re-enforced by the customary supply of the rear cockpit. The latter has been abolished, and a chamber developed within the fuselage for the carriage of a litter and a man, with a maximum clearance of 17 inches and a minimum of 14 inches Substantial modification of Stations 5, 6 and 7 has been made, and ancillary longerons (to serve as a bed for the litter) introduced as shown in Cross Section Drawing 208. This modification has compelled the removal of the top horizontal tuning wires, and the fuselage cross section wires of, and between, Stations 5, 6 and 7. In compensation is offered the bracing system exhibited in Cross Section Drawing 208 and Drawing 302.

I have been assured by the engineering office of Mather Field that the ambulance fuselage is fully as strong as the original type, and, in fact, (due to the method of engaging the litter in the litter chamber, and the additional horizontal tuning wires introduced in the opening that was formerly the rear cockpit) substantially stiffened in its longitudinal axis

The usual turtle-back is unchanged, save that a stronger and more dependable locking device has been employed (See detail Drawing 302)

Additional protection against the air (especially in case of pronounced

Additional protection against the air (especially in case of pronounced shock) may be secured by clamping into place the translucent celluloid shield indicated in Drawing 208. The use of this shield is optional. The litter (Drawing 208) is essentially the service litter with but scant modification. The stirrup feet have been replaced by strap iron feet of simple design and less weight, so placed that they will escape the fuselag longrons. The hinged braces have been replaced by lighter rigid iron braces. The former rectangular canvas bed has been slightly tapered toward the feet to conform to the usual taper of the fuselage.

Strong clamps, activating on the eccentric principle and attached to the longeron litter bed (detail, Drawing 302), engage in the litter longerons, which have been suitably metal-sheathed for their reception

Substantial web belting with safety buckles (of the type commonly employed in the cockpits) pass over the patient at the level of the knees, the pelvis and the lower thorax To control the possibility of the body slipping (in the event of forced acrobatics), similar belting, strongly attached, on



#### THE AMBULANCE AIRSHIP

either side of the head, to the re-enforced canvas of the litter, passes over each shoulder to decussate at the mid-sternal line and find attachment, on the litter longerons, at the points which likewise control the chest belt. It seems highly improbable that the patient (well wrapped in blankets over which the belting should engage snugly) will appreciably shift position, even though the ambulance ship, pursued by the enemy, be compelled to engage in acrobatics

The general plan of this ambulance ship would seem to be capable of ready adaptation to any ship, domestic or foreign, whose fuselage approximates in type the JN4D, and whose structure and power warrant the transportation of two men Parenthetically, it may be noted that the burden of this ship, when loaded, is but slightly in excess of an unaltered twin ship carrying two men and the usual equipment Furthermore, it is of practical interest that the weight centers of this ambulance ship will not be altered to any significant extent

The ambulance airship should be distinctively differentiated from other ships. To that end it would seem wise that the entire color scheme be either white or cream-white, and that upon the upper surface of the upper wings and the lower surface of the lower wings, likewise upon the sides of the fuselage, the Geneva Cross, in brilliant red, be boldly displayed

Such distinctive differentiation is likewise advised for ambulance ships in "the zone of the advance", though it were but fatuous cherishing of a fond delusion to assume that the gentle Teutonic art of "schrecklichkeit" toward the sick and wounded, would be modified in favor of an aerial ambulance, be it differentiated ever so clearly.

Standard equipment should include an axe, a saw, pair of heavy bolt cutters, mesh splints, tourniquet, aromatic spirits of ammonia, hypodermic case, canteen of fresh water, not less than two substantial wool blankets should be included, and a vacuum bottle, replenished daily with hot coffee or hot soup, may prove of the greatest life-saving value, especially during the rigorous winter months. A first aid cabinet, extending the width of the fuselage (to house these necessary articles) will prove quite accessible, if carried as indicated in drawings 208 and 302

But, as two men are requisite for proper manipulation of the patient, two ships invariably should be sent to all remote plane accidents. Ship I (ambulance) carrying pilot and empty litter, Ship 2 (ordinary) carrying flying officer and passenger (any ordinarily intelligent man will serve)

Without engaging in any comparison with other ambulances, the following technique is submitted for consideration, and attention is directed to its simplicity and effectiveness from the standpoint of the aviator-patient

At the earliest moment following notice of a remote accident, the ambulance ship, accompanied by a companion ship (as above noted), proceeds to the indicated vicinity. A thorough search of the terrain by the two ships should identify the wreckage with reasonable promptitude, landing is accomplished, the aviator is freed from the wreckage (saw, axe and bolt-cut-

#### NORVELLE WALLACE SHARPE

ters carried by ambulance ship), lifted on blanket covered litter, first-aid relief extended (all material carried by ambulance ship), wrapped snugly in blankets, strapped on litter, deposited in ambulance-fuselage-litter-chamber, litter clamped into position, turtleback and celluloid shield clamped in position, return flight begun

Note The patient is handled but once

On reaching the field, patient (strapped on litter) is removed from the ambulance ship, transported to operating room, removed to operating table, again being handled but once

Note — Cordial recognition is made for the helpful cooperation and counsel tendered by Capt Sylvanus C Coon, Lieut Royal Miller, Lieut Mead T Mulvihill, Lieut Murray S Vosburg and Lieut S S Kingman

### TRANSACTIONS

OF THE

### NEW YORK SURGICAL SOCIETY

Stated Meeting, Held October 9, 1918

The President, DR CHARLES H PECK, in the Chair

#### COMPOUND COMMINUTED FRACTURE OF THE LEG

DR JAMES M HITZROT presented a man aged twenty-nine, who was admitted to the New York Hospital on September 23, 1915, with a history of having fallen two stories from a scaffold. He was brought by the ambulance to the hospital and sent to the operating room immediately. There were open fractures of both legs in the middle third. Both tibiæ were extensively comminuted. On the right side, the lower fragment was protruding from the leg.

Operation —Iodine skin preparation Right leg The extensive skin wound was enlarged, and the wound trimmed away to healthy skin. The leg was fractured from the middle half to just below the tubercle of the tibia, all the bone in that particular region being comminuted, the number of fragments being possibly eight. The lower end projected through a large lacerated wound and the upper fragments were driven into the muscles of the calf. A Quenu-Mathieu extension apparatus was applied. By turning the extension screws, the comminuted fragments were drawn into fair alignment. The wound was then filled with balsam of Peru, dressed with gauze dampened with saline, and left wide open. Only one small bone fragment was removed, the others all having periosteal attachments.

The instrument used did not prevent a certain amount of lateral rotation in this particular case, so that the displacement of the bones could not be said to be absolutely overcome. It did, however, maintain alignment and allow for easy access to the wound

Left leg The region of the fracture in the left leg was exposed by a 4-inch incision and practically the same condition was found as in the right leg, except that the comminution was not so extensive A Freeman external bone clamp was applied so that the screws were fastened in the normal bone above and below the line of fracture and the fracture reduced, alignment in this instance being maintained very satisfactorily. The wound was filled with balsam and the skin incision loosely closed with silkworm-gut stitches, leaving three or four nation openings through which the exidate could escape. The wound was then dressed with saline and both legs put up in Volkmann gutter splints

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Four days after the operation, a superficial infection developed in the right leg with the greyish sloughy appearance characteristic of gas bacillus infection. Smears showed a large Gram-positive organism of the capsulatus aërogenes type—subsequently reported as Bac aërogenes capsulatus (Welchii) from culture. The leg was irrigated with I per cent formalin and dressed with peroxide. After two days the character of the infection changed and the odor disappeared.

The patient ran a temperature of only 101 5 but was unusually restless, and on the seventh day the left leg was found so twisted that the two upper screws of the Freeman clamp were twisted out of the bone. On the ninth day an infection developed in the left leg which remained quite superficial (albus and colon) and did not involve the bone.

On the twenty-fourth day after operation, the Quenu-Mathieu apparatus was removed and a fragment of dead bone picked out of the wound The perforating points of the drills were touched up with silver nitrate The wound was dressed with balsam of Peru and Volkmann tin splints applied

On December 15, the granulating surfaces of the legs were cleaned with soap, water and benzine Quite a marked degree of union was found in the left leg in which there was hardly any motion at all A short posterior moulded plaster splint extending from below the knee was applied. The right leg still had considerable lateral anterior posterior motion at the site of the fracture with practically no motion at the knee joint. Long posterior and external lateral splints were applied, extending above the knee

The patient was in the hospital 132 days Upon discharge, the left leg was solid and the wound was almost healed. The right leg was firm but not solid, and there was a discharging granulation area about the centre of the leg. One month later, on the one hundred and fifty-fourth day, the right leg was solid and the patient was allowed to walk on it without crutches.

The man now has good function in both legs and works daily

DR JAMES M HITZROT also presented a man, aged twenty-four, who was brought to the New York Hospital on October 31, 1917, with a history of having been crushed between the front of a trolley car and a wagon. On admission he had suffusion of the upper chest, neck and face, an abrasion over the back, and an open fracture of the left leg with extensive skin destruction and laceration. The patient was brought to the operating room about one hour after his injuries

Operation —Iodine skin preparation The devitalized skin over the anterior edge of the tibia was carefully excised and the wound opened so as to expose the entire line of fracture. The middle third of the bone and a little of the upper third were extensively comminuted, the bone being crushed into twelve or more fragments. The dorsal extensor muscles of the foot were extensively lacerated and in many places completely cut in two. All of the devitalized muscle tissue, the loose fragments of bone which had no attach-

ment, and the shredded fascial sheath of these muscles were carefully excised, and all pockets carefully opened. The entire wound was then irrigated with I per cent formalin solution followed by ten volume peroxide and then irrigated with normal saline solution. The extensive loss of the bone made it impossible to fix the distal portion of the leg in appliance directly used on the outside. A Quenu-Mathieu apparatus was applied, the two fixation pins being passed through the tibia above and below the line of fracture, after which the bone fragments could be held in more or less satisfactory position. The wound was then dressed and the leg put up in a Volkmann tin gutter splint.

On the fourth day, Dakin-Carrel treatment of the wound began On the fifth day, the skin over the posterior aspect of the leg about the middle was found to be dead, and this was excised from time to time

On the ninth day, a purulent exudate began to show itself, especially on the marrow surfaces of the fragments of bone

At the end of two weeks the leg was put up in moulded plaster splints with strip steel reinforcement, but this proved unsatisfactory because of the moisture, and in the seventh week, the patient was put up in a Hodgen splint using the lower pin of the Quenu-Mathieu apparatus for extension The upper pin was removed at the same time

The amount of the infection was readily controlled by the Dakin-Carrel treatment but increased in amount each time dichloramine-T was used This infection was maintained chiefly about the bone fragments, especially on the medullary surface. It was deemed unwise to remove these, as new bone was forming from the periosteal side of these fragments until the seventy-seventh day, when they had loosened and were easily removed, after which the infection rapidly decreased. On the eighty-ninth day a portion of the large granulating area was skin-grafted (Thiersch method)

The leg was placed in moulded plaster splints and the patient allowed up on the ninety-sixth day

On the one hundred and twenty-sixth day there was a gap of 134 inches between the upper and lower side of the newly formed bone. To bridge this gap, an operation with bone graft was done, although it was realized that the graft could not be placed in an absolutely sterile field. A six-inch graft was placed across the gap (inlay) removed from the opposite tibia (March 13, 1918). On the twelfth day after operation, a small infection formed over the centre of the graft and the graft became loose and was removed on the forty-sixth day. New bone had formed at both ends in the region of the graft, and only in the region of the early infection was there an absence of bone formation (eleven and one-half months)

There is now 34-inch of separation between the bone ends, but the X-ray plate shows new bone growing up the posterior aspect of the gap and the patient is wearing a brace to await developments

The case is shown to illustrate how a satisfactory leg may be obtained

#### NEW YORK SURGICAL SOCIETY

after an extensive injury which at first seemed to warrant amputation. The first case shown, taken as a standard, shows how much this second man may eventually expect.

#### COMPOUND FRACTURE OF THE ELBOW

DR JAMES M HITZROT presented a man, aged thirty-seven, who was brought to the New York Hospital with a history of falling through an open hatch, a distance of twenty-two feet, striking on the right elbow

On admission he was found to have an open fracture of the olecranon, with anterior displacement of the forearm on the humerus Three and one-half hours after injury, he was taken to the operating room

Operation - Iodine skin preparation Under the anæsthetic, the whole olecranon process and portion of the shaft of the ulna were found to be smashed The opening through the skin connected with the open elbow joint This opening was excised and the whole region of the fracture exposed by a long linear incision. There were three loose fragments of bone on the radial side of the olecranon and one smaller fragment was attached to the internal lateral ligament As this fragment could not be controlled and was quite small, it was likewise excised with the loose fragments. A heavy plain catgut suture was then passed through drill holes in the ulna, and through the triceps tendon at its attachment to the olecranon and drawn taut. This approximated the bone fragments satisfactorily Interrupted plain catgut stitches were then passed through the torn expansion and through the muscles, approximating them around the fractured area and closing off the During the operation, the elbow-joint was washed with saline The skin was closed with interrupted silkworm without drainage and the arm put up in an anterior moulded plaster splint

The wound healed by primary union It is now thirty-four days after the operation, and the patient can flex the arm thirty degrees plus, and has free motion without pain for that distance He is receiving massage and the motion is steadily increasing

Dr. Charles H Peck said that these cases illustrate in a way the tendency that is seen so much in war wounds to save limbs after extensive comminution of bone. This effort is proving successful in a great many cases by conserving most of the fragments that have any periosteal attachment and removing those only completely detached and keeping the line of the wound clean. The early mechanical sterilization of the wound is successful in a large number of cases, and is one of the points in treatment which is being carried out extensively and successfully in saving limbs which otherwise might require amputation.

DR FRED H ALBEE (by invitation) said that at General Hospital No 3 there have been a large number of returned cases showing that bone fragments comminuted by fracture do live and in many cases completely restore the shaft of a long bone. Of the large number of such cases coming under

#### POST-OPERATIVE VENTRAL HERNIA

his observation he had been especially interested in a case which illustrated this point well. In an infected compound communited fracture from gunshot injury there were a large number of necrotic bone fragments from the effect of the infection which ensued at the time of injury three months before, one piece, however, had been driven so far out into the muscle by the high velocity of the bullet that it had become walled off from the infected pocket and its cells escaped death. The amount of subsequent bone growth from this fragment was very striking. In fact the fragment had tripled its size

He wished to reiterate that he has found that these fragments will live and help restore the loss of bone even though they may be entirely detached

# POST-OPERATIVE VENTRAL HERNIA WITH PROLAPSE OF EXCLUDED ILEOCÆCUM

DR SETH MILLIKEN presented a boy who was admitted to the second Surgical Division in Roosevelt Hospital, September 11, 1918 His history was that two years ago he had been operated on for acute appendicitis at a hospital out of town A fecal fistula developed following the operation and about a year ago at a hospital, said to be in the city, but where the record is not available, he was operated on again and says that the small intestine was joined into the large intestine and that since then no fæces have come through the old wound, but that the bowel has come out

Examination shows a large mass of large intestine prolapsed through a right intermuscular defect into which the entire hand can be inserted, that is, the hernial ring is about four inches in diameter. The boy is well developed and bright and complains of the mass on the abdomen

There was a large median firm scar and at the site of the intermuscular incision there protruded the mucous membrane of the cæcum, a short portion of the ascending colon and a portion of the ileum. Finger exploration of this mass when re-introduced showed apparently a blind end of the ileum, but no obstruction in attempting to pass up the ascending colon. Barium injected into the opening of the mass gave an X-ray picture which apparently showed normal ileum, cæcum and ascending colon, but on close inspection it seems that the ileum proper went into the hepatic side of the transverse colon

Operation (September 16, 1918) —Under ether anæsthesia the prolapsed gut was inverted into the abdomen and packed with gauze. The entire surface was thoroughly swabbed with iodine and an incision carried around the former scar about a quarter of an inch from the margin of the hernia and dissected up so that the two margins of the wound to be excised could be sutured together. This was done and the opposed surfaces swabbed with pure carbolic and a towel clamped about the opening. The wound margin was then re-swabbed with iodine and the operation proceeded with by dissecting down and opening the peritoneum and circumcising the margin of the

#### NEW YORK SURGICAL SOCIETY

There were very few slight adhesions in the iliac fossa which were easily separated without bleeding The wound was sufficiently large to retract easily upward and revealed a side-to-side anastomosis of the ileum and the transverse colon with the closed end of ileum toward the right. The ascending colon was freed and crushed off near the hepatic flexure with a Payr clamp and the cæcum and ascending colon removed The crushed margin was seared with phenol and a running stitch passed over the clamp into which the end was inverted. A second Lembert stitch of linen was placed over this end reinforced with interrupted Lembert stitches as a third layer There were no apparent soiling of the peritoneum The peritoneum was closed in layers and the muscles freed slightly so as to give These were united under considerable tension in three distinct layers layers and the aponeurosis firmly united with plain gut anteriorly The skin was approximated with silkworm gut and silk after thoroughly cleansing the surface of the wound before closing the skin Silkworm gut twist drain was inserted in the lower angle of the skin wound, no drain being inserted below the aponeurosis

The boy made an uneventful convalescence following his operation, except that three small areas of infection developed in the length of the wound in the skin. These have drained superficially and are healing by granulation at this time

#### HOSPITALS OF THE AMERICAN EXPEDITIONARY FORCE

DR CHARLES H PECK presented a paper with the above title, for which see page 463

#### LIPOMA OF THE THIGH

DR WILLIAM B COLEY presented a specimen, a very large lipoma of the thigh which had been removed on the morning of the same day, October 9th The patient, a woman thirty-five years of age, first noticed a swelling in the posterior and middle portion of the right thigh about seven years ago. The tumor gradually increased in size until it had reached such large proportions that it was regarded as inoperable

This case is particularly interesting from a diagnostic standpoint. She was admitted to the Memorial Hospital on the supposition that the trouble was a sarcoma of the muscles of the thigh. However, on a careful examination of the tumor in connection with the history of its development there were a number of features which favored a diagnosis of lipoma. First, the very slow growth of the tumor (seven years) was against its being a sarcoma. Second, the mobility of the tumor was much more marked than one would expect to find in a tumor of either fascial or muscular origin. Third, the consistence of the tumor was so soft that it closely simulated a cyst. Introduction of an aspirating needle, however, brought no fluid, thereby showing that it could not be a cyst. Had it been a vascular sarcoma it would have been possible to obtain a few drops of blood with a needle

#### LIPOMA OF THE THIGH

The diagnosis of lipoma was confirmed by an exploratory operation in December, 1917, and the question of removal of the tumor was carefully discussed. Operation was not strongly urged on account of the large size of the tumor. The patient went home and returned again two weeks ago, at this time being willing to have the operation performed. She had had six X-ray treatments in this interval without any noticeable effect. On October 9th, under ether anæsthesia, Doctor Coley, with the assistance of Doctor Hoguet, operated and the lipoma was shelled out with perfect ease, and there was practically no hemorrhage. A considerable portion of redundant skin was removed along with the tumor. The lipoma weighed 7 pounds

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## TRANSACTIONS

OF THE

# PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, held January 7, 1918
The President, Dr Charles H Frazier, in the Chair

# THE DANGER OF THE PERNICIOUS BOND SPLINT IN CARPAL FRACTURES OF THE RADIUS

DR JOHN B ROBERTS said that successful treatment of the usual fractures near the carpal end of the radius demands (1) Free separation of the basal from the shaft fragment, whether impacted or entangled (2) Forcible reduction until the normal arch of the palmar surface of the radius near the wrist is restored (3) Retention of this concave anterior surface of the carpal fifth of the radius (4) A flexed wrist-joint during convalescence and abstinence from the use of a flat splint for support, on the palmar aspect of the forearm and hand, aid greatly in preventing displacement of the carpal piece after its reduction. This is particularly the case in comminution of the lower fragment.

In his opinion "Bond's splint," so much used in Philadelphia, is an anachronism and should be discarded from use as a dressing for these fractures

- (a) Some of them need no other dressing after reduction than flexion of the wrist-joint maintained by a rigid material
- (b) Others require a straight strip of wood or metal on the dorsal surface from mid-forearm to metacarpal-phalangeal joint or a convex incompressible splint of cork, wood, metal, or hardened plastic material to support the arch in the anterior surface of the lower fifth of the radius
- (c) Still others, because of severity of the vulnerating force or brittleness of bone, do better by being encased in a Levis splint, of swedged copper on the palmar surface of the forearm and palm of hand, or else a molded gypsum gauze splint covering the dorsum of the forearm and hand, applied before the plaster of Paris is set. Both of these dressings should keep the wrist flexed during their use because the extensor tendons have a tendency to hold the fragments in place. These conformed dressings usually are not needed for more than three or four weeks, even in severe injuries

In illustration of these statements he described a case in which the original fracture, not originally under his care, had been apparently a comminuted and backward displaced fracture of the lower end of the bone. A Bond splint had been applied with a pad of gauze under the lower end of the radius with the idea of holding the fracture in adjustment. When seen by him three weeks after injury, there was marked prominence of the head of the

ulna at the back of the wrist and some displacement of the carpal fragment forward. The patient was suffering great pain until he removed the dressing and substituted a gypsum gauze retentive apparatus until he could persuade her to take ether and allow him to reconstruct the lower end of the bone. She delayed this operation for about three weeks. He then, under ether, pushed the lower fragment upward so as to bring it into proper apposition with the shaft. The deformity due to the apparent dislocation of the head of the ulna disappeared.

This confirmed his opinion that the lower fragment of the radius, because of the use of the Bond splint and a possible mal-adjustment during the first three weeks after injury, had been displaced forward without rupture of the radio-ulnar ligaments. This gave the appearance of a radio-ulnar dislocation.

He had seen fractures with backward displacement treated with the Bond splint in which the displacement had apparently been reproduced by the support not being properly obtained under the arch on the palmar surface of the lower part of the shaft. He thought that in the case now reported the pad of the Bond splint, which goes in the palm of the hand, probably caused the secondary deformity by reason of causing motion at the seat of fracture instead of at the wrist-joint. This is his explanation of the change during the Bond splint treatment from a backward displacement to an anterior displacement of the carpal fragment. He believed the Bond splint to be a dangerous form of splint for fractures of the base of the radius. It should be discarded from the surgeon's outfit

DR JOSEPH M SPELLISSY thought that the Bond splint, which Doctor Roberts condemned, could be used with great advantage if it were properly padded. The arch of the wrist needs to be preserved. Of course, if the Bond splint is used without building up, the hand is thrown into the wrong position, aggravating the deformity. Oakum can be used to advantage for padding, since it is soft but can be molded into shape and is better than gauze. If the fracture be reduced over the knee and the hand put in the proper position, it has the grasp needed, the oakum fills up the space and if necessary repeated dressings can be inserted under the lint used to cover the oakum. The splint takes up very much less room and is less expensive than the more elaborate forms.

#### IMPASSABLE TRAUMATIC STRICTURE OF THE DEEP URETHRA

DR T TURNER THOMAS gave the history of a man, thirty-eight years old, who was admitted to the University Hospital October 29, 1917. Has always been strong and healthy. January 19, 1917, while at work in the mines, was squeezed in the pelvic region between two cars. After being in a hospital for thirteen days following the injury, he was operated on but does not know the purpose of this operation, except that a rubber drainage tube was passed from one groin to the other, evidently above and in front of the bladder. He says that he could void urine before the operation by the normal

#### PHILADELPHIA ACADEMY OF SURGERY

route fairly well The tube was removed a week after operation, but on the following day urine escaped from both openings in the groins and ceased to pass by the urethra The opening in the right groin closed and has remained closed since, but that in the left groin has drained urine periodically since but has not in the last two weeks

A second operation was performed March 1st, its purpose being to cause closure of the urinary sinus in the left groin and the re-establishment of urination by the urethra. The bladder was opened suprapulically and the urethra through the perineum, a tube being passed from one opening to the other. This was removed eighteen days later under an anæsthetic. Urine passed through the urethra two or three times after this, then ceasing and soon making a new opening for itself in the right buttock. The urine afterward escaped by this opening and that in the left groin

In July a third operation was performed for the purpose of re-establishing normal urination, only a median perineal incision being made. This attempt also met with failure. At the time of admission to the University Hospital he had for some time been urinating only through the opening in the right buttock and seemed to have good control. He did not soil his clothing and could get to the toilet in time, although he sometimes had to hurry. He voided about every two hours

Operation was performed at the University Hospital, December 6, 1917 A suprapubic incision was first made, considerable difficulty being experienced in deciding that the bladder had been opened because of its small size, its displacement to the right, and the fact that no prostate or urethral orifice could be detected. A probe passed into the urinary sinus in the right buttock failed to reach far enough to be felt by the finger in the bladder and probably did not get to the bladder or urethra A No 26 F sound introduced by the meatus passed to about the anterior layer of the triangular ligament, a No 20 a little farther, but it could not be felt by the finger in the bladder An incision about an inch long was then made in the midline of the permeum to the end of the sound, thus opening the urethra There seemed to be at least an inch between the end of the sound and the finger in the bladder which was trying to feel the sound through the intervening tissues With no guide on the inside to indicate the former position of the internal urethral orifice, now probably replaced or closed by cicatricial tissue, the re-establishment of the obliterated portion of the urethra presented difficulty It was decided to force the end of the sound onward into the bladder and later to maintain the track thus made if possible For a small distance the sound seemed to be opening up a contracted urethra but for the greater part seemed to be making a new path for itself The finger could not reach to where the sound came through the mucous membrane, but at this stage and in passing other instruments afterward an assistant by his finger in the rectum determined that the rectal wall had not been penetrated The sound was then withdrawn and a grooved staff introduced into the badder, on which as a guide a long-bladed bistoury, with its edge turned downward and

to the right, was passed along into the bladder, thus increasing the calibre of the new opening. A No 26 metal catheter was then passed and its outer end fastened to the penis, to preserve as far as possible the normal shape and curve of the urethra. The lower part of the suprapubic opening was closed by two silkworm-gut sutures, in the upper part a rubber tube being introduced and fixed by suture. The considerable oozing was controlled by gauze packing, and the perineal opening was also thus packed

The patient had one chill with a moderate rise in temperature after operation, but aside from this did remarkably well. The suprapubic drainage tube was removed in one week and the urine ceased to escape from it in about two weeks and from the perineal wound in about three weeks. The metal catheter was removed twenty-nine days after operation. It was immediately afterward reintroduced and this was followed by a No 28 F and a No 29 F sound, showing that the new uiethra was easy to follow with such instruments. On the next day Nos 26, 28 and 30 were passed, the last with considerable distress. These were passed daily for about two weeks and then every two days until the patient was discharged from the hospital December 26, 1917. He left the city soon afterwards and has not been seen since, but he promised to have the No 30 F sound passed regularly, twice a week for a time and less frequently later.

#### BILATERAL RENAL CALCULI WITH ENTEROVESICAL FISTULA

DR ARTHUR E BILLINGS recited the history of a man, aged forty years, who, since 1906, has had occasional pain in his back, at times with frequent micturition Since childhood he has complained of an "irritable bladder" In the autumn of 1909 he had a severe kidney attack and, after being confined to bed for three or four days, developed severe abdominal pain, persistent vomiting, and absolute constipation, which was diagnosed as intestinal obstruction by his physician and consulting surgeon. He was relieved of this without operation. Soon after this he expelled gas and he thought a slight amount of fecal matter from his bladder. In 1913 he had another renal attack and was in bed for several weeks, after this he had a cystoscopic examination by his physician and was told that he had ulcers in the bladder, which were probably tuberculous and that one of the ulcers communicated with the bowel He was admitted to the Pennsylvania Hospital September 25, 1916, with a temperature varying between 101 and normal, for six days, and a moderate leucocytosis. In the meantime he was skiagraphed and large stones were revealed in both kidneys with the bladder and ureters negative. At this time there was tenderness over both kidneys, both were palpable, and the left seemed definitely enlarged, where his pain and tenderness were greatest. A phenolphthalem elimination test showed 13 per cent for the first hour and 12 per cent for the second hour Cultures of his urine showed colon bacilli and Bacillus pyocyaneus. A cystoscopic examination and ureteral catheterization was not done because it did not seem wise under the condition. Wassermann examination was negative. Elimination was

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encouraged and favored in every way Supportive and local treatment, consisting of irrigation, etc., was instituted, and benzoic acid was given as a urinary antiseptic, because his urine was persistently alkaline and loaded with phosphates and urates. His lowest point in urinary elimination was 20 ounces in twenty-four hours. On November 16th, his general condition had greatly improved, temperature had been normal for three weeks, leucocytes had dropped from about 24,000 to normal, and his average urinary output was above 60 ounces for twenty-four hours, with considerably less pyuria

Operation —Under morphia and atropine and nitrous 'oxide-oxygen anæsthesia the left kidney was exposed through the usual costo-ilial incision. It was very adherent, but was delivered and the cortex split longitudinally, the stones were removed and the wound in the kidney was closed with catgut mattress sutures. The kidney pouch was drained. There was a moderate amount of urinary drainage for the first fifteen or eighteen days. He made an uneventful recovery and was discharged December 12, 1916. He was re-admitted January 26, 1917, after having gained considerable weight and generally improved.

Second Operation (February 1st) -Under morphia and atropine and nitrous-oxygen anæsthesia the right kidney was exposed in the same manner as the left and it also was very adherent and there was considerable bleeding both from the adhesions and the incision of the kidney, which was also longitudinal through the cortex The stones were removed, the kidney was closed and the bleeding controlled with catgut mattress sutures was drained as on the left side with a rubber covered gauze drain fourth day after operation his abdomen became greatly distended, with persistent vomiting, and evidences of a mass in the right lower quadrant and the suprapubic region were discovered At the end of twenty-four hours he had expelled gas and was a little improved During this twenty-four hours his urinary output was about 50 ounces. On the sixth day he was much improved, the mass disappeared and the situation cleared up with the several bowel movements On the eighth day he had quite a discharge (2 or 3 ounces) of fæces with a lot of gas from his bladder This persisted for two or three days, his bladder was irrigated sixth hourly and a continuous catheter kept just within the bladder for a few days and 5 per cent silver iodide emulsion instilled twice daily Aside from this his recovery was uneventful and he was discharged March 23, 1917, both wounds having healed and being in good condition

There was no gross clinical evidence at the time of operation of tuberculosis in either kidney. At this writing he has a slight pyuria, but has not had any further fecal discharge from his bladder, although he thought shortly after leaving the hospital, while acutely constipated, that he passed gas from the bladder. His general health is greatly improved and he has added considerable weight (about 20 pounds)

DR B A THOMAS, supplementing what Doctor Billings had said, re-

#### BULLET REMOVED FROM LEFT LUNG

ported another case of bilateral renal calculi with also bilateral urethral calcult The case is that of a boy aged twenty-three years, who, his mother said, had passed two stones from the urethra at the age of two years and during his early life he had two attacks of illness which were diagnosed appendicitis The immediate history of the case is that eight weeks prior to the time he was seen by Doctor Thomas, which was last summer, after having joined the Army, he was seized with a violent attack of left-sided That is the side which shows one stone in the lower left ureter This attack lasted for four weeks, after which he was entirely free from pain until fire days prior to the time he saw him when again he had an attack and was admitted to the Polyclinic Hospital At that time he had considerable suppression of urine, he was extremely toxic Cystoscopic examination was made and indigocarmine was found to be eliminated on the right side, not until twenty-five minutes This is the side in which there were the three or four stones On the left side there was no elimination for that length of time A urethral catheter was obstructed on the left side at a distance of The patient was losing ground, and was very toxic It was decided to do only a nephrotomy on the left side which was the side in which there This was done, but four days later, although for two was no function days there seemed to be improvement, he died, apparently from suppression of the urine The stones removed were stuck so tightly to the kidney tissue that it seemed almost as if they would break in removing them. Possibly this boy had had renal calculi from the time he was two years of age

### BULLET REMOVED FROM LEFT LUNG

DR GEORGE P MULLER reported the history of a man, aged thirty years, who was admitted to the Polyclinic Hospital October 23, 1917, suffering from a gunshot wound of the left lung. There was a wound of entrance but not of exit. There was some dyspnæa, but no other symptoms, and the physical signs were those of moderate hæmothorax. The patient was not very much shocked, and was rather under the influence of alcohol

On the following day the X-ray examination revealed the bullet to be in the lower lobe of the right lung. On the same day he developed delir-ium tremens and was quite ill for about one week, by which time he was suffering from dyspnæa from the increasing effusion in the chest. There was also marked aphonia, but this could not have been caused by any injury from the bullet. There was also a great deal of pain at the suprasternal notch.

Operation was done under ether anæsthesia (open method), October 31, 1917. A long incision was made over the fourth rib and about four inches of this resected. After cutting through the intercostal membrane the pleura was separated up and down for a little distance and then opened, and then the cavity was found to contain 600 c c of bloody and serous fluid. The lung was adherent to the diaphragm and was separated from this adhesion with difficulty. The bullet was felt in the lower lobe and the lung was

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brought up into the wound and, by squeezing, the bullet made prominent A small incision over it allowed it to be popped out. The lung was dropped back into the cavity and the pleura, muscles, and skin sutured

A beginning was made to dry out the cavity, but, as the patient did not do well, this was abandoned. It was not possible to entirely suture the pleuia. The patient stood the operation well and, although at times was rather dyspnœic, this was controlled by drawing the lung into the wound and steadying the mediastinum. The patient made an excellent recovery and six days after operation was up and about the ward

#### A FAT-FASCIA-BONE TRANSPLANT FOR DEFECT OF SKULL

DR PENN G SKILLERN, JR, reported the following case

J V, male, white, aged thirty-two, tiler, was admitted to Polyclinic Hospital (Case Record No 32216—service of Dr George P Muller) on October 26, 1917 Discharged improved on January 15, 1918

History of Present Condition — Eighteen months ago—on May 7, 1916—the patient suffered a gunshot wound of head Immediately upon being shot he had convulsions on left side, involving arm and leg, he then fell upon the floor The bullet entered the right frontoparietal region and passed backward and downward toward the right occipital bone, against which it lodged it had not been removed. Three months after the injury—in August, 1916—the first operation was performed the wound was "cleaned out". The paralysis did not improve after this operation and convulsions continued. Three months after the first operation (six months after the injury)—in November, 1916—the second operation was performed "a piece of bone was removed." After this operation the convulsions disappeared and the patient began to move the left leg.

Physical examination reveals a trephine opening in the right fronto-parietal region, which opening is partially filled in around the edge. There is hemiplegia of the left side, excluding the face. There is an intention tremor—the limbs can be moved if the patient contracts other muscles first, and when the limbs move they exhibit marked tremor. The reflexes are exaggerated, including the deltoid, biceps and wrists, knee-jerks and Babinski ankle-clonus is present. The flexors of the fingers are somewhat contracted

The skiagram (Fig 1) showed the bullet to right of and just above the external occipital protuberance and very close to it, resting upon the tentorium cerebell. The wound of entrance is revealed as an irregularly circular defect in the right frontoparietal region, over the upper portion of the fissure of Rolando seen through this defect is a cluster of spicules of bone, apparently carried into the brain by the bullet

The patient wanted something done in an operative way for the following reasons. Up to the time of the receipt of the injury he had been a vigorous, able-bodied man who worked hard at his trade (tiler). With the exception of the left-sided hemiplegia he still retained these pristine physical qualities and brooded over his inability to work. He therefore wanted an attempt



Fig i —Preoperative skiagram orientating bullet in posterior cranial fossa and showing defect in frontoparietal region. Note spicules of bone in brain as seen through the defect—these spicules were carried into the brain by the bullet in its course.

made to restore the usefulness of his limbs. He also complained that every time he moved his head he experienced in the back of his neck a creaking sensation, as of two pieces of leather being rubbed together. So, too, the defect in the skull, which he could plainly feel, preyed upon his mind and gave him a sense of insecurity.

A study of these propositions from a surgical standpoint did not offer, in the first instance, much hope in the restoration of the usefulness of the limbs. The hemiplegia was doubtless due to destruction of motor cells in the precentral gyrus with subsequent cicatrix formation in the path of the bullet. The only hope in this direction lay in freeing the brain from scartension, by removing the dural scar and as much as feasible of the scar-tissue formation that had filled in the path of the bullet. As to the removal of the bullet, such a procedure from a practical surgical standpoint had no indication it was merely to gratify the patient's wish and relieve him of the paræsthesia of which he complained that this step was contemplated. As to closure of the skull defect, no objections could be found why this should not be accomplished.

Accordingly, the bullet was removed on November 13, 1917, through an osteoplastic flap. The wound healed uneventfully, and the patient no longer complained of his "leather" paræsthesia. Examination of OS after operation showed the vision the same as that in OD the patient did not lose the sight in his left eye, as was predicted by an eminent neurologist in case the bullet were removed.

The second operation was performed twenty-four days after the first—December 7, 1917 As this operation is believed to present a more or less original method of closing a skull defect—original in the preservation of the connection of the deep fascia and fat with the bonegraft—the following details have been extracted from the history sheet

Horseshoe flap of scalp with base below raised, exposing trephine skull defect and adjacent bone. Scar-tissue raised from brain and freed from edge of skull defect. Brain opposite latter more or less disorganized—surface flattened, no convolutions visible. A dense body was palpated in the brain this was removed and proved a fragment of bone twice the size of a grain of rice. There was some bleeding—arterial spurts and venous oozing—from the median portion of the wound, but this was controlled by packing. The superior sagittal sinus was not opened. The wound was now packed and temporarily closed with a silkworm-gut suture, preparatory to removing the graft from the tibia.

The upper broad subcutaneous surface of the left tibia close to the tibial tubercle was exposed and cleansed with iodine. A goblet-shaped incision was made over this area, and the skin with a thin layer of subcutaneous fat was reflected. The fat, still attached to the deep fascia and periosteum (including tendinous insertions of sartorius and gracilis muscles), was cut wider than the button of bone to be removed, the excess of soft tissue was gathered into the mouth of a 1½-inch trephine, and the button of bone was re-

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moved The medullary tissue and endosteum were scraped away from the graft The leg wound was closed

Going back to the skull, the silkworm-gut suture was removed, as well as the packing The fat-fascia-bone graft was inverted, so that its medullary surface lay uppermost (1e, toward the scalp) and its fat surface most deeply (1 e, against the brain) Six interrupted sutures of chromic gut No 00 were applied so as to secure the edge of deep fascia and periosteum to that of the dura these sutures were left long The edge of the skull defect was freshened and drilled in two places at opposite poles, and the graft was drilled in similar manner sutures of No 2 chromic gut were threaded in these holes The gauze packing inserted to control hemorrhage was now removed, and the graft inserted with fat resting against the brain tion dural sutures were tied first, and the two retention bone sutures were tied next The graft fitted snugly in position, there being left a small slit between the graft and the skull defect anteriorly and a smaller one between the graft and the skull defect posteriorly. The scalp flap was now replaced and sutured with interrupted sutures of silkworm-gut. At the close of the operation the patient's pupils were contracted (1-16-inch) and reacted to light, they were of equal size

Postoperative Note (January 15, 1918)—It is now nearly six weeks after the second operation. The bone graft has incorporated itself with the skull. As to motor improvement the patient can move his left arm through a wider range, and the intention tremor has disappeared. The finer movements of the fingers have not returned yet. He is able to move his left leg to limited extent and can walk with a cane.

The advantages of the combined fat-fascia-bone graft in this case are obvious. Fat is the tissue best adapted for contacting with the brain substance and serves the double purpose of controlling hemorrhage from the latter primarily and later of preventing adhesions between the cortex of the brain and the sutured duraplasty area. The deep fascia and periosteum are tissues homologous with the dura in structure and in function. The endosteum and medullary substance were removed from the graft to prevent bone formation beneath the scalp. By maintaining these three layers of tissue still connected and in normal relationship with one another favorable conditions of nutrition could be early and readily established

The following extract, culled from the literature of war surgery, is of interest in connection with this case

C Villandre, writing upon the repair of cranial defects (Presse méd, 1917, 300), has, during ten months, personally operated upon 106 cases of loss of cranial substance. The procedures employed were (1) cartilaginous cranioplasty, (2) osteoperiosteal grafts taken from the tibia, (3) sterilized bone plaques, (4) paste composed of carbonate and phosphate of lime for small breaches.

The statistical results of the four procedures are as follows Osteoperiosteal grafts, 32 successes in 32 cases, or 100 per cent, cartilaginous cranio-

plasty, 46 successes in 48 cases, or 968 per cent, sterilized bone plaques, 18 successes in 22 cases, or 818 per cent; lime paste, 2 successes in 4 cases, or 50 per cent

A graft of living substance—bone or cartilage—removed from the patient himself and at a distance from the site of the loss of substance, is therefore the most practical and the surest method of repairing a loss of cranial substance

As regards the question of ablating portions of the altered cerebral cortex we cite from the following not dissimilar case of Kalb (Deutsche med Wchnschr, 1917, No 5), which was that of a boy fourteen years old who for ten years had been epileptic. There was a history of infantile cerebral paralysis. In the pre- and postcentral gyri there were numerous brown-red patches of infiltration containing in certain parts small cysts.

"As complete extirpation of the altered zone would have resulted almost certainly in total paralysis of the right limb, I dissected out from the altered parts small islets varying in size from a lentil to a pea and for a depth of 5 mm. About a dozen such were removed, constituting about two-thirds of the altered parts of the grey matter. Islets of normal cortex remained. There was some language disturbance following operation, but after a week this as well as the limb paralysis improved. After four weeks the patient could walk with the aid of a cane. After one year and a half psychic phenomena have disappeared, the general intelligence is better and the patient can walk for some hours."

DR CHARLES H FRAZIER remarked that cranioplasty was one of the most popular topics of discussion in the surgery of the war zone. Many articles are to be found in literature bearing upon this subject. The points which are of principal interest to the surgeons of the war zone to-day seem to be (1) as to whether the defect should be repaired, (2) when it should be repaired, (3) how it should be repaired.

Whether the defect should be repaired depends to a large measure upon its size. Apparently there is a unanimity of opinion that if the defect be large it should be repaired. Many patients so afflicted have a great many subjective phenomena, as in the case just reported by Skillern, which they attribute to the presence of the defect. There are a few surgeons and a few neurologists who are disposed to believe that in epilepsy it is wiser to leave the defect alone, on the ground that anything which tends to increase intracranial pressure acts as a predisposing factor. This phase of the subject is too large to dwell upon here. Suffice it to say that there are two schools, one which believes that epilepsy is due to increased intracranial pressure, the other that increased intracranial pressure is an accompaniment but not the cause of the seizures.

Regarding the time at which defects should be repaired, there seems to be an almost unanimity of opinion that operation should not be done until at least eight weeks after the wound has entirely healed. In the speaker's opinion, it should not be done for six or eight months after the accident because the incidence of infection is too great when the operation is per-

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formed sooner, that is in case of gunshot wounds that were, as most of them are, the seat of infection

As to how it should be done—this is a matter of comparative simplicity. The repair of defects with bone or cartilaginous grafts is one of the simplest of surgical procedures. He had had a number of cases in his clinic at the University Hospital, and in these he had practised a modification of the technic of the so-called Konig-Muller operation. The graft is removed from the parieto-occipital region and is composed of the pericranium and outer table of the skull—not the entire thickness of the skull nor the pericranium alone, it is necessary to remove only a thin shell of bone. The graft is transferred to the defect, the margins of which have been previously freshened, dura freed from the margins and in some instances removed. In the course of six or eight weeks one finds consolidation at the site of the defect complete.

With regard to the technic which seems to be popular in the war zone, particularly with the French surgeons, cartilage is used rather than bone Cartilage does not become absorbed, it does not shrink, it maintains its vitality and merely changes its residence from one part of the body to another. The supply is secured from the cartilage of the ribs. Some surgeons have taken bone grafts from the tibia or scapula, some from the scapula of the lower animals, some have used the Konig-Muller operation, some of the skulls of those that have been killed in action, others foreign material such as ivory and silver plates.

The points that have been emphasized in the technic are the following In the first place the graft should be autoplastic rather than homoplastic or heteroplastic His results with the bone graft justify the employment of bone, although cartilage may be more readily obtained and answers the purpose quite as well The defect must be carefully prepared—this includes freshening of the margins, the freeing of the dura from its adherence to these margins When the dura is incorporated in a thick scar and the latter is adherent to the cortex, he excises it, scar and dura together. The graft should be laid in the defect with its smooth surface toward the brain Usually he has fixed it in place with a few interrupted sutures through the pericra-Some surgeons place the margins of the graft between the dura and the bony margins of the defect, some make a trellis-work with catgut sutures passing across the defect Hæmostasis is regarded as a sine qua non, and if it is not possible to control bleeding from all sources, a drainage tube should be used Some surgeons recommend the exposure of the defect with a crucial incision, although he prefers a horseshoe-shaped flap

The results of cranioplasty, from the standpoint of the repair of the defect, are almost universally good. He had seen reports of cases where, in removing the graft from the tibia, the latter has been broken or the wound became infected, but these are complications that should have been avoided Insofar as the operation affects the relief of such symptoms as headache, dizziness and the like, possibly more than half of them are successful. Statistics vary as to the influence of the operation as a prophylactic or in relieving epilepsy. On the whole, reports more than justify the undertaking

# LUMBAR PUNCTURE AS APPLIED TO CRANIOCEREBRAL SURGERY\*

In all cranial traumatisms accompanied by cerebral symptoms, lumbar puncture reveals at once by the presence or absence of blood the existence or non-existence of a craniocerebral lesion

In meningeal affections an examination of the cephalorachidian liquid with reference to its chemical composition, cytological and bacteriological elements, gives important information as to various morbid states of the central nervous system and its envelopes

For these reasons the author, Dr F Albert, believes lumbar puncture to be a diagnostic resource reliable and valuable. The researches of the author have been done at the Military Hospital of Hoogstaede, Belgium, under the direction of Professor Willems. His conclusions are supported by a large number of clinical observations. The most important of his conclusions may be summarized as follows.

- I In all doubtful cases of fracture of the skull or of intrameningeal hemorrhage, lumbar puncture, by the character of the cephalorachidian liquid removed, will determine at once the diagnosis
- 2 Lumbar puncture is capable of determining with certainty the differential diagnosis between simple congestion and irritation as distinguished from local compression of a latent zone of the cerebral cortex
- 3 Lumbar puncture constitutes an infallible means of distinguishing simple cerebral hernia from the symptomatic cerebral hernia of abscess of the brain or of encephalitis. Each time that the hernia does not subside completely after lumbar puncture, the inference is conclusive that there is present a foyer of encephalic infection.
- 4 Every case of cerebral concussion and congestion is always accompanied by excessive secretion of cephalorachidian liquid producing phenomena of congestion. These reveal themselves by the ordinary symptoms of compression. In such cases lumbar puncture is the treatment especially indicated, since it removes at the same time the effect and the cause.
- 5 Lumbar puncture is the only really efficient treatment of fracture of the base of the skull
- 6 All cases of irritation of the cortex and of Jacksonian epilepsy to which no apparent external cause can be given are influenced favorably by lumbar puncture, though it has no direct effect upon the local cause, it may, by diminishing vascular tension, render the local cause inefficient. Every time that the puncture is without effect, one may be sure that there exists a gross cause of irritation and explorative craniectomy should be done.
- 7 Cerebral hernia may always be made to recede and disappear completely by a successive series of lumbar punctures, if these are resorted to early, before the hernia has contracted adhesions, and especially before it has become fleshy and irreducible. Once such a hernia has been reduced, the author recommends, in order to prevent return, that a secondary suture of the wound should be made with, if possible, immediate cranioplasty

<sup>\*</sup> Abstract from Lyon Chirurgical, t xv (April, 1918), page 328

8 Repeated lumbar puncture to a full degree is the treatment of choice possessing real value in cases of post-traumatic meningitis, even in those due to staphylococcic and streptococcic infection. In such cases of infection advantage will be obtained by association of the lumbar puncture with intrarachidian serotherapy followed by decubitus with the head lowered

Technic—The author prefers in all cases that the patient who is to be subjected to lumbar puncture should be placed in the sitting posture. The patient is seated on the edge of the bed, with legs hanging over. An orderly sits in front of him and takes the legs of the patient between his legs, so as to immobilize them well. The patient rests his own head against the breast of the orderly and bends his back as much as possible. Whenever the condition of the patient is such as to make the sitting posture impractical, a lateral decubitus is chosen. The area of the puncture is cleansed with ether and iodine.

For the first puncture, the point of election is always between the fourth and fifth lumbar vertebræ. As a guide to this, the spine of the fourth lumbar vertebra is first carefully identified. This may be found exactly in the line which crosses the two iliac crests. The point of this spine being fixed by the index finger of the left hand, the needle is inserted a centimetre to the outside and below. An error which is often committed at this point is to direct the needle too much upward and toward the median line. It is necessary, rather, to press the needle straight forward, deviating very little toward the median line. If one observes this precaution, the needle will pass without difficulty between the laminæ and penetrate directly into the subarachnoid space. It is very exceptional to strike against the lamina. No anæsthesia, even local, is ever necessary. A very little practice is required to enable the operator to perform the procedure without the least difficulty even in patients who are the most intractable

The cephalorachidian liquid is received into sterile graduated glasses. In cases of vascular tension (congestion) as much liquid as possible should be withdrawn. The feeling of the individual should be the guide. As a general rule, these cases support an amount of removal to an astonishing degree (from 30 to 40 cc and even more). The patient announces himself the moment when it is necessary to stop the removal, that is to say, when he begins to complain of headache. This headache, sometimes quite violent at the moment, passes away after a few minutes with the dorsal decubitus. Most of the patients suffer no discomfort whatever from the lumbar puncture. In cases where the puncture gives exit to a bloody liquid, the indication is to alter the position of the point of the needle so as to determine whether or not a vein has been pricked. In such case, as soon as the needle is withdrawn or is plunged in a little more deeply, the liquid clears up, and by receiving the liquid successively into different glasses, finally a perfectly clear liquid is obtained.

When the case under treatment is one of cerebral hernia, the hernia is to be kept uncovered, simply protected by a layer of sterile gauze, so that an assistant can observe the course of the hernia while the puncture is going on, and the puncture is terminated when the hernia has entirely withdrawn into the cranial cavity

In the treatment of meningitis, a simple evacuating puncture should be followed by antistreptococcic serotherapy, that is to say, after taking away as large a quantity of the cephalorachidian liquid as can be borne until the patient begins to complain of headache, an intrarachidian injection of the antistreptococcic serum is made and the patient placed in an oblique decubitus position, with the head low, and kept for some hours

If in the course of a series of punctures it happens that no liquid can be obtained by puncture in the usual place, it will be due to clogging of the needle by a fibrinous clot or by blocking up of the subarachnoid space at that level by fibrinous coagulum. In such case, one should ascend a space and go on as before

# PRESENT-DAY VIEWS OF THE PATHOLOGY OF SYPHILIS\*

In a lecture delivered before the Harvey Society at the Academy of Medicine, New York, December 8, 1917, Professor Alfred Scott Warthin discussed certain recent additions to our knowledge of the pathology of syphilis

He begins by calling attention to the fact that, until within the past year, the entire literature of syphilis has confined itself to the grosser lesions which were evident in the course of ordinary autopsies. Thus, of 4880 autopsies performed at Bellevue Hospital, which were analyzed by Symmers, anatomic evidence of syphilis is recorded to have been present in only 314 cases, or 65 per cent of the whole. On the other hand, however, in the University Hospital at Ann Arbor, whose clientele is drawn chiefly from a rural population representing middle-class farmers, village storekeepers, mechanics and laborers, of 750 autopsies made during the last ten years, evidences if syphilitic infection were found in 300 cases or in 40 per cent of the entire autopsy material. It is inconceivable that such a population as that constituting the clientele of the Ann Arbor Hospital should contain a greater proportion of syphilized individuals than do the classes which form the clientele of such a hospital as Bellevue Hospital, of New York

The difference is explained, however, in the difference in pathologic criteria employed in the two instances mentioned. One represents the results of attention merely to gross pathologic anatomy, the presence or absence of gumma being the chief criterion upon which the conclusions were based. In the latter institution conclusions were based upon the revelations of microscopic pathology, and it is to microscopic pathology of latent syphilis that the lecture of Professor Warthin is largely devoted

The discovery of the spirochæte pallida, as the etiologic agent of syphilis, at once brought about a change in concepts of the pathology of the disease. This change in our concept of the pathology of late or latent syphilis has resulted in displacing the gumma as the type of that lesion and in demonstrating that the viscera are involved in all cases of latent syphilis, not necessarily, by gummatous processes, but by specific inflammatory processes proceeding to fibrous processes that are usually mild in character, but which acquire pathologic importance because of their progressive character

Taking up, first, cases of congenital syphilis dying before or at birth, the spirochæte pallida may be found often in enormous numbers in the heart muscles of such subjects, producing by their colonization focal fatty changes in the myocardium and a specific type of interstitial myocarditis. Spirochætes are often present in great numbers in the tissues of congenital syphilities in which the changes noted have not been produced.

In cases of acquired syphilis, lymphocyte and plasma-cell infiltrations were associated with spirochæte localizations, although they were not so readily demonstrated in the tissues and organs of known cases of acquired syphilis, aortic aneurisn, tabes, paresis, etc, nevertheless, their presence was demonstrated successfully in such a large number of cases as to make the specific syphilitic nature of these lesions certain

In the progress of these studies, the specific inflammatory lesions of spirochæte localization have been found in the myo-, endo- and pericardium, the aorta, the pulmonary and other large arteries, nervous system, liver, pancreas, adrenals, testis, prostate, prevertebral and mesenteric tissues. These lesions vary greatly in size, from minute collections of a few cells to larger infiltrations visible to the naked eye. Every stage of development from the early active lesions to complete healing and fibrosis was

<sup>\*</sup> American Journal of Syphilis, vol 11, No 3, 1918

observed, but no cases were found in which there were no active lesions. Complete healing throughout the body was never observed. The marked tendency of the lesions to undergo fibrosis and healing with the formation of dense hyaline scar tissue was a striking feature. This tendency may be regarded as an evidence of the relatively avirulent character of the organisms.

The author proceeds to an examination of the lesions found in the different tissues of the body. In the nervous system the most constant changes were those found in the meninges. In practically every case of latent clinical syphilis autopsied some degree of thickening of the meninges was noted. The occurrence of active lymphocyte and plasma-cell infiltration in the meninges in old latent cases of syphilis seemed to parallel the degree of activity of the lesions found in the heart, aorta and other tissues. In general, however, the author believes that probably every case of old syphilis will present in the brain and cord the same scattered perivascular infiltrations of lymphocytes and plasma cells found in all other organs and tissues. Such infiltrations represent simply the local reaction to the presence of spirochætes. Their relations to paresis and tabes may be simply one of degree, the symptoms of the diseases named being dependent upon the amount of destruction of nerve tissue and the consequent functional disturbances produced.

The heart in every case showed microscopic lesions characteristic of spirochæte localization. The cardiac lesions vary greatly in degree. In many cases no fibroid changes were visible to the naked eye, and the occurrence of fibrosis and active infiltrations was determined only by the microscopic examination. It must be emphasized that the determination of cardiac syphilis is essentially microscopic. Even though no myocardial changes may be seen by the eye, the microscopic examination may reveal the most extensive lesions. This is especially true of the more acute and active cases.

The essential lesion of cardiac syphilis is an interstitial myocarditis characterized by infiltrations of lymphocytes and plasma cells along the vessels between the muscle fibres. The entire heart wall, from epicardium to endocardium, including the papillary muscles, may be involved in the infiltrations, but in the average case they lie nearer to the endocardium, often just beneath it, or in the middle layer of the myocardium. In the great majority of cases the myocardium shows healed fibroid areas in association with active infiltrations.

A progressive fibrosis of the myocardium always takes place. In the great majority of cases of latent syphilis the left ventricle was dilated, and such dilatation was either the chief or accessory cause of death. The fibroid heart is the ultimate outcome of all cases of latent syphilis

Likewise, in the aorta the gross appearances are no absolute criterion of the aortic condition. Whenever the picture is that of arteriosclerosis no positive exclusion of syphilis can be made without a microscopic examination. The aorta may present no changes, or very slight ones, to the naked eye, but the microscopic investigation may show characteristic plasma cells along the vasa vasorum of the media and adventitia. The cases recognizable by the naked eye as syphilitic aortitis are old cases. Similarly, in cases of latent syphilis careful examination may show active areas of plasma-cell infiltration in the tissues of the pancreas, liver, adrenals and testes, the spirochætes can be demonstrated in the active cellular infiltrations similarly in other organs and tissues of the body

The pathologic lesions as described are common to all cases of old syphilis (secondary stage onward) They were found not only in known active cases of late syphilis, but also in cases with a history of the disease which had been treated and regarded as cured, in cases with negative and in cases with positive Wassermann reactions. In the great majority of those cases in which, upon autopsy, were found

to be present these conditions, no history had been presented and no clinical signs or symptoms had been interpreted by clinicians as indicating syphilis. Probably many of those patients never knew that they had syphilis, the infection being either congenital or accidental. The symptoms predominating had not been such as were likely to arouse suspicion of any relationship to an old syphilitic infection.

The conclusion of the author is that syphilis as a latent infection is very much commoner than is generally supposed, and that the proportion of syphilities in our ailing class is very high. As to the proportion of that class in our population, he believes that the previous estimates of from 5 to 15 per cent are all too low. He himself would place the incidence of syphilitic infection in this country as nearer 30 per cent. He says that an analysis of our vital statistics will show that at a very low estimate about one-tenth of the deaths occurring in the United States can be attributed to syphilis. Death is rare in the first two years after infection. The incidence of syphilitic death increases progressively with the years after infection. It is particularly the cause of death in millions between forty and sixty years of age, and since its symptomatology at this stage is in the majority of cases either myocardial, vascular, renal, hepatic, etc., it is not recognized clinically as syphilis

As to curability, Warthin says that he has never seen, pathologically, a cured case of syphilis In all cases examined at autopsy active areas of specific inflammation are always seen, and such areas mean always the persistence of the spirochæte these intratissue parasites should in cases without symptoms and negative Wassermann reaction be regarded in the same light as that in which we look upon the streptococci of the mouth cavity. Does the spirochæte cease to be a cause of disease and the body become a carrier of relatively or even quite completely harmless organisms? That some progressive injury is being caused is demonstrated conclusively by these Immunity to the spirochæte pallida, and probably to all other organisms that enter the body tissues, or, perhaps, even its passages and cavities; is paid for with a price—the price of defense. The infiltrations of lymphocytes and plasma cells in themselves may cause damage-infinitesimal, perhaps-but when persistent over a period of years may finally produce functional disturbances. The persistent slight damage and necessary repair of fibroplastic proliferation and the eventual fibrosis explains the latent period of syphilis and final outcome in such terminal conditions as aortitis, myocarditis, pancreatitis, etc The majority of cases of syphilitic infection die from the results of these slow, mild inflammatory processes in the viscera and blood-vessels rather than from paresis or tabes Doctor Warthin is convinced that the great majority of all cases infected with syphilis die of chronic myocarditis

The syphilitic is always pathologically "damaged goods", and the damage is a progressive one. He wears out sooner, his viscera more quickly reach their histogenetic limits, he actually becomes prematurely old, and there is a constant strain upon his defensive powers. All of these are arguments for the prevention of syphilitic infection rather than for its cure. No man who has acquired syphilis, though he may become clinically cured (which, as far as we know, means latency of the infection, that is, spirochæte carrying), can have the same potential body-value and expectancy of life as before the infection

This pathologic conception of the syphilitic as probably always a spirochæte carrier, once the infection is acquired, should influence the therapeutic management of this chronic infection. The syphilitic, even when apparently perfectly well, should have his life laid out for him along lines tending to prevent the reawakening of the virulence of the organisms or an increased susceptibility of the body tissues and organs. This is done for the patient who has once had clinical tuberculosis, when properly treated his future life is planned to prevent the reawakening of his infection, because he, too, is usually, if not always, still a carrier of the infective agent

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But in the case of the syphilitic, such hygienic measures are not applied, implicit reliance is usually placed upon a certain amount of salvarsan or mercurial treatment, while the infected individual is permitted to take up his life again as if he were an ordinary individual, and, as a rule, he succumbs prematurely to the stress and strains incident even to ordinary living. The treatment of syphilis, as it is ordinarily carried out, looks only to the present moment, it should look to the whole future life of the infected individual.

Syphilis tends to become a mild process, but at any time the partnership between the body and the spirochæte may become disturbed, and tissue susceptibility or virulence of the spirochæte become increased so that the disease again appears above the clinical horizon

The pathologic diagnosis of syphilis is essentially microscopic Only in a relatively small number of cases are the gross lesions (tabes, gumma, aortitis, etc), typical enough to be recognized by the naked eye. A negative diagnosis of syphilis cannot be given with any certainty without a routine microscopic examination of all organs and tissues, but particularly of the left ventricle wall, the aorta, both its arch and abdominal portion, the testes, pancreas and adrenals

# THE SURGERY OF GUNSHOT INJURIES OF THE THORAX

During the past year under the auspices of the American Red Cross in France a Medical Research Society has been maintained at Paris for the benefit of the medical officers of the American Expeditionary Forces Meetings have been held by this society every month, with an average attendance of about 200 medical officers representing the various hospitals and divisions of the American Expeditionary Forces. These meetings have proved to be in the highest degree practical and helpful, not only in stimulating and correlating the experience of the American medical officers, but also in bringing them into a closer acquaintance and more cordial relationship with their French and British conferers

The proceedings of this society are being published in monthly numbers under the title of War Medicine The publication is to be edited by Major Seale Harris, M R C The first number, bearing date of August 4, is now before us It contains the report of the papers presented before the society at its meeting of June 28 and 29 last The theme under discussion was wounds of the chest. Of the important papers presented we subjoin the following direct

Col P B Soltau, R A M C, said that chest wounds formed on an average 2½ per cent of all casualties admitted to the cosualty clearing stations, and on occasions the number had arisen to 3½ per cent. The mortality calculated from the returns made from the British front during the fighting in 1917 was, at the field ambulance stations, 7 per cent, at the casualty clearing stations, 17 18 per cent, at the base, about 6 per cent

The causes of death were two-fold, anatomical and septic. The anatomical causes included gross lesions, with profound shock and hemorrhage, the complicating lesions involving abdomen and other areas, the multiple wounds, and deaths from ædema of the lungs and asphyxia

In the field ambulance zone the death rate was due entirely to anatomical causes. In the casualty clearing stations it was due to both anatomical and septic causes, while at the base it was entirely septic in origin

The septic causes were due to infecting organisms of various types, namely, gasforming organisms, 48 per cent, streptococcic, 40 per cent, and lung organisms, 12 per cent. The streptococcic infections were the most fatal. The septic death rate in the casualty clearing station area was about 26 per cent of all deaths. Of every 100 men wounded in the chest, about 9 die of sepsis. This is the death rate which surgery has the greatest hope of reducing

Types of Wounds—The character of the missile was naturally responsible for a great variety of wounds. Large shell fragments would smash many ribs, lacerate the parietes extensively and destroy a large area of lung. Shell fragments of whatever size were more likely to be retained inside the thorax than were, bullets. Bullet wounds might also vary greatly in degree. A perforating bullet might traverse the lung and yet cause no discoverable lesions. At times, on the other hand, most extensive injuries were seen from such bullets. This was due partly to the oscillating movement of the bullet, which, in addition to its forward movement and its rotation around the long axis, imparted by rifling, had potential rotation around its short axis, most marked at the early and late stages of the flight, and made active whenever the missile encountered resistance. This short-axis rotation was responsible for many of the so-called explosive effects

The Nature of the Injuries—(a) To parietes—All degrees of muscle-and-bone injury may be met with. The muscles of the shoulder girdle were liable to gas infection, wounds in that area needed most careful watching "Stove-in" chest was a term applied to a chest in which many ribs had been fractured and fragments had been driven into the pleura. This formed a most dangerous wound and one that until recently has been nearly always fatal. In such a desperate condition operative measures were justified, however, as constituting practically the only hope, for even if the patient survived the initial shock, fatal sepsis nearly always supervened

(b) To lung Lacerations of the lung, hæmothorax and collapse of lung, either singly or in combination, were the conditions met with As regards the injury to the lung, the most common condition was infarction along the bullet track. Sepsis in the wounded lung was not very frequent, as that organ had a remarkable power to deal with infection within its substance. As to cases of hæmothorax, in the majority of cases blood was poured into the pleural cavity from the lung and not from torn intercostal vessels. Collapse of the lung was an almost invariable condition

With regard to the pneumothorax, there was one condition requiring emphasis, namely, that known as the "sucking wound," where air was being drawn in and out of the pleural cavity through the wound. The constant variation of intrathoracic pressures and the oscillations of the mediastinum in this case caused profound shock and rendered the patient very prone to sepsis. It was imperative to close such a wound at the earliest possible opportunity. Since the adoption of this practice, a great improvement in the results had been seen

The Unwounded Lung—Particular attention must always be paid to the condition of the unwounded lung, upon which largely depended the fate of the patient Frequently there was observed an area of collapse, which varied in degree from a partial deflation to a massive collapse of the lower lobe Contralateral bronchitis and cedema were also very frequent Stress was laid upon these conditions, as their existence was a bar to operation

Shock—Chest wounds are liable to be accompanied by profound shock. These wounds are pre-eminently the wounds in which a production of acidosis was favored. This was due to pain, exhaustion, diminished oxygenation, forced respiratory movements and impeded circulation.

Treatment—The speaker called attention especially to the following points Combating of shock by careful warming, the relief of pain by morphine or its derivatives, the securing of a comfortable position for the patient, the suturing or plugging of an open wound, the evacuation of the case to a casualty clearing station as soon as the primary shock is overcome

At the casualty clearing station the first essential is to secure rest, with immediate examination confined only to determining whether there is bleeding or a sucking wound. The more detailed examination is to be postponed for some hours, when an exact diagnosis as to the condition present should be made with X-ray localization.

of foreign bodies Sepsis is to be continually watched for Large hæmothorax accumulations should be relieved by aspiration, which is best done about forty-eight to seventy-two hours after wounding. As regards surgery, the large open wounds or the "stove-in" chest require plastic repair and closure. Large retained foreign bodies should be removed after accurate localization. The infected chest should be treated either by cleansing and closure or by drainage.

Evacuation—This is a constant problem, especially in times of active fighting. In quiet times it is better to evacuate the straight-forward cases either at the end of three days or to wait until after ten days. The intervening period is the time when sepsis appears, and it is better not to let cases travel during the period. In rush times, however, all wounds unaccompanied by an extensive parietal injury, in which the hæmothorax is not excessive, may be evacuated within twenty-four hours, provided the primary shock is overcome. After operation cases should be retained for at least ten days. The open or draining chests travel badly. Cases should not be evacuated within twenty-four hours after aspiration.

Surgical treatment concerned only a small portion of the cases In these the highest skill was necessary, and for the remainder the painstaking care of the physician was needed

### EARLY OPERATIVE TREATMENT IN CHEST SURGERY

Major A L Lockwood, R A M C, premised that the complete intrathoracic operations which he was about to describe should be undertaken only in cases likely otherwise to prove fatal. In the earlier years of the war an expectant treatment of chest wounds prevailed, and even excision of the parietal wound was not undertaken unless it was badly infected. It was soon recognized, however, that chest wounds involving the diaphragm and abdomen demanded immediate operation, that the repair of the diaphragm was observed to be more urgent than that of any abdominal viscus, and that, in general, operation should be undertaken as early as possible. In 1916 repair of the diaphragm by the abdominal route became a routine procedure. The procedure finally evolved included excision of the parietal wound and removal of fragments, and, when possible, closing of the pleura. No attempt was made to clear the hæmothorax, or to follow the missile or to repair the thoracic content.

When it was found that, even without sepsis, death resulted usually from badly comminuted parietal fractures, it was made a routine practice to operate immediately all "stove-in" chests

The treatment of thoracic wounds of the diaphragm is best conducted by the thoracic route

In the case of sucking wounds, which had previously proved invariably fatal, it was found practicable to excise the parietal wound, clear out the hæmothorax and close the chest wall As; soon as the leakage is stopped, great improvement is at once apparent and the lung tends to expand

For resuscitation, the patient is placed, if possible, with the injured side dependent Continuous rectal installation of a 5 per cent each of soda bicarbonate and glucose in water is started. An intravenous soda bicarbonate 2 per cent solution may also be given. In severe cases blood transfusion (600 to 800 c c) is administered. Hot drinks by mouth, but no stimulants, should be given. Sleep should be induced by every possible means, including morphine. Dyspnæa from hæmothorax or pneumothorax should be relieved before operation by aspiration.

The most perfect operative conditions are essential to success. The following rules are the result of experience

- I Operate as soon as patient's condition allows
- 2 Operate when injury to the diaphragm is suspected
- 3 Operate when evacuation will not be necessary
- 4 Operate in all cases of open pneumothorax

- 5 Operate on all badly "stove-in" chests, even if there is no external wound
- 6 Operate in all cases where a large missile has traversed the pleural cavity, wherever it may be lodged
  - 7 Operate on all badly infected wounds, even if the missile is not retained

Most complete and constant X-ray investigation is necessary Full sized stereoscopic plates should be taken. Early operation on cases showing signs of bronchopneumonia on the uninjured side must not be undertaken lightly and only with local anæsthesia.

The operative theatre should be heated uniformly to 80 degrees F Perfect asepsis should be maintained

The local anæsthesia should be preceded by a preparation of the skin with a 3 per cent alcoholic solution of picric acid. Novocain 5 per cent and potassium sulphate 0.25 per cent in a normal freshly prepared saline is used for the local anæsthetic. To this solution to minims of adrenalin per ounce are added just before use

Paravertebral anæsthesia is administered two or three spaces above and below the wound. A local infiltration at some distance from the wound is employed

The most serious cases may be operated on with a light nitrous oxide analgesia Nitrous oxide gas and oxygen should be available for administration when the hand is inside the chest or when the patient is restless. Local anæsthesia combined with gas and oxygen is the best means of preventing shock in extended operations. Neither ether nor chloroform should be used in chest surgery.

When the position of the wound permits, resection of the fourth rib from the midclavicular to the posterior axillary line furnishes the easiest access to the thoracic cavity. Resection of the ribs should be wide enough to allow full and careful inspection of the cavity. Doyen's periosteal elevator and costotome are the instruments best suited for resection of the rib. Tuffier's retractor is useful.

The thoracic cavity must be mopped out with gauze wrung out of hot saline carried on a long curved forceps of the Ochsner pattern. When a missile has pierced the diaphragm and entered the liver, the diaphragm must be excised widely enough to expose the tract in the liver, and the missile removed. The liver tract should be cleansed with Volkmann's' spoon, followed by swabs wrung dry out of saline and ether.

If oozing occurs, deep catgut sutures should be inserted with a blunt needle Mattress sutures suffice to close the diaphragm except when it is stripped from its parietal attachment. The diaphragm, however, need not be sutured to the chest wall

It is wise to deal with abdominal wounds after the closure of the chest

Partial lobectomy may be necessary, depending on the degree of laceration of the lung. Total lobectomy and excision of both middle and lower lobes of the right lung have been done for acute malignant gas gangrene, but it has not saved the patient's life. An open bronchus is rarely found at operation. Crushing and ligaturing with catgut is sufficient.

The visceral surface of the lung should in all cases be approximated, thus mechanically retarding effusion from the damaged lung, and lessening the tendency for infective conditions to light up in the lung substance itself. Hemorrhage from the lung need not be feared

All foreign bodies and blood clots should be removed from the thoracic cavity. The toilet of the pleura can better be performed by sponging (as in the case of the peritoneum) than by washing out. The last step before closing out the peritoneal cavity is to sweep round the chest wall, lung, mediastinum and diaphragm systematically with swabs wrung dry out of hot saline, and, finally, with a swab wrung dry out of warmed ether.

The chest should always be closed, unless there is extensive gas gangrene of the lung tissue itself adherent to the chest wall. Time should not be wasted in attempting to repair the parietal pleura in extensive wounds, as it can rarely be done, such pleura

as remains can be caught up with the muscle sutures. The chest must be hermetically closed with the first layer of muscles, otherwise pocketing will occur, pleural effusion accumulate, the incision break down and the operation fail. From the time the pleura is opened until it is closed, when the hands of the operator are not actually in the chest, the hole in the pleura should be covered by thick lint, wrung dry out of hot saline. This closure is important, even if only for a moment at a time Careful approximation of the skin edges is necessary to ensure early and absolute primary union.

A wide gauze dressing reduces the tension on the sutures and binds the layers of the chest wall so as to prevent oozing and pocketing. A binder made of seven-inch adhesive plaster (tying over the dressing) is valuable to retain the dressing, as well as to relax the tension on the sutures and leave the sound side of the chest free for expansion, the latter is extremely important

On completion of the operation, the patient should at once be supported in a semi-recumbent position inclined to the injured side

The two-stage operation is indicated in the type of case with the entrance and exit wounds far apart—front and back or lateral—where gross lesion of the bone or extensive destruction of the tissues necessitates an extensive operation of both wounds. In such a case, enter the chest through the wound which allows freest access to the pleural cavity and to the part probably damaged. After carrying out the operation as outlined above, leave the patient on the table in a comfortable position, surrounded by hot-water bottles. Give intravenous sodium bicarbonate or blood transfusion as required, administer sodium bicarbonate and glucose 8 ounces per rectum. Half an ampoule of omnopon should be given if the patient is at all restless. After one or two hours, deal with the other wound. For the second stage, a further paravertebral anæsthesia is frequently not required—merely local infiltration about the site of the incision.

Injuries of the heart or pericardium can be best dealt with by a parasternal flap of the fourth and fifth, or the fifth and sixth, costal cartilages, depending on the probable site of the lesion (the divided cartilages unite rapidly), and this route, in addition, gives free access to the pleural cavity

Where the missile has passed across the pleural cavity and lodged in the mediastinum, especially high up, it is wiser to enter the mediastinum through the sternum. The missile should be removed, its bed and track thoroughly cleaned and the pleural opening closed to prevent any leakage from the mediastinum into the pleural cavity. This serves a double purpose—it obliterates a pocket in which pleural effusion might accumulate, and shuts off from the pleural cavity a source of reinfection. It is difficult to deal with the mediastinum through the usual costal incision.

Gross lesions of the parietes under the scapula are always difficult to reach. It is possible to deal with such wounds from either vertebral or axillary border

Above all, speed and absolute asepsis are essential to success. The operation must begin with excisio in toto of the wound and end with hermetical sealing of the thorax

In no class of surgery is team work so essential to success. The surgeon, physician, radiographer and anæsthetist should work hand in hand. The theatre nurse should be particularly quick and methodical, knowing each step of the operation, and avoiding delay by having everything prepared in advance and at hand. A postoperative nurse, who has had long experience in the nursing of these cases, is a most important member of the team.

### SECONDARY SURGICAL TREATMENT OF CHEST WOUNDS

Doctor Tuffier said that the surgical operations necessitated by the complications which follow wounds of the chest are relatively few. He divided them into two classes, namely, aseptic complications, which include foreign bodies, hæmothorax, pul-

monary sclerosis, and possibly later, pulmonary tuberculosis, and (2) infectious complications, including purulent pleurisy, abscess and gangrene of the lungs

Foreign bodies should be extracted after the usual process of localization only when they cause functional troubles which can be definitely traced to their presence When the foreign body is aseptic, the phenomena attributed to it, he believed, were due to pulmonary sclerosis. In a great many cases the functional troubles, such as pain, dyspnæa and difficulty in respiration, persist after removal of the body in exactly the same degree as before

Chronic hæmothorax may present either of two forms—an extensive effusion, or a limited interlobar effusion

The seriousness of hæmothorax arises not only from its long duration, but from the fact that the corresponding side of the thorax collapses, retracts and brings about a definite deviation of the spine, with diminution of the respiratory field. After a very long time the hæmothorax gives way to a probable sclerosis, or the X-ray reveals a considerable thickening of the pleura, and the physical examination a diminution of the vesicular murmur. It is generally situated at the base and posteriorly

Efforts to render the prognosis of this condition more favorable have not been very successful. At present the speaker said that he treated all cases very early (within from seven weeks to two months) by pleurotomy, with evacuation of the fluid and wide separation of the ribs, by means of his "separator" If the chest is immobile during respiration and very resistant to the touch, he decorticates it. If, however, the lung is still flexible, he merely opens the wound, thoroughly cleans out all false membranes and closes the incision, whereupon the pneumothorax thus created subsides definitely

Limited Interlobar Hamothoras—Only four cases of this condition had come under his observation. Under the X-ray they presented a regular spheroid tumor about the size of a large tangerine orange, absolutely limited, with sharply defined edges, without sclerosis, without condensation of the pulmonary parenchyma and without any apparent lesion of its periphery. After puncture, the cavity collapsed to a great extent

Pulmonary tuberculosis has been noted in a small number of cases. These he considered to be due to suppuration, to hospitalization, or even to individual predisposition. The tuberculosis often develops in the lung on the side opposite to the lesion. An operation done in one case was perfectly successful

2 Septic Conditions, Complications Due to Infection with Purulent Effusions of the Pleura—The method of treating cases of purulent pleurisy involves chemical disinfection of the wound, followed by closure of the suigical incision, both in medical purulent pleurisy and in post-traumatic surgical suppurations

The treatment of pleural suppuration in an unopened cavity comprises three steps (a) Pleurotomy, (b) Chemical disinfection, (c) Closure

First step—Plemotomy There are two kinds of cases to be considered, according to whether the purulent pleurisy is of pneumococcal or non-pneumococcal origin. In the first class a simple intercostal pleurotomy is advocated. The incision is made at the point where the slope is greatest in the superior axillary line. The orifice is enlarged by the "separator," which allows a complete evacuation of the fluid and false membranes to be made.

In the second class of cases, non-pneumococcal, a thoracotomy with resection of a single rib is preferable. It allows of the complete evacuation of all exudates, the inspection of the whole of the pleural cavity and examination of the lung. The exploration of the pleural cavity is important. Should the pleuro-pulmonary fold be found much thickened at any point, that part of the pleural fold should be excised and decorticated. Foci of suppuration completely isolated from the pleural cavity may thus be revealed.

The final step should be the insertion of Carrel tubes for disinfection of the thoracic cavity. Seven or eight of these tubes are placed into all the recesses, even the furthermost, in every direction. They are fixed to the skin by a piece of adhesive plaster.

The chemical disinfection of the cavity is effected by injecting Dakin's fluid through each tube every two hours. The bacteriological examination is made by taking a swab once a day from the discharge at three points, the surface, the track and the deep recesses. After a period of from nine to thirty days at the maximum, the pleural cavity becomes sterile and the surgical wound is closed.

As soon as sterilization has been effected the incision is to be closed

Treatment of Purulent Fistulæ—Cases in which, after the purulent pleurisy has been opened, a fistula remains, with persistent suppuration. First, a bacteriological examination of the discharge should be made by swabs taken from the three points already mentioned

The treatment comprises three steps (1) Debridement and loosening of the pleural adhesions (2) Chemical disinfection (3) Closure, which is here quite different from the operative method

First step Loosening of the Pleural Adhesions—This follows after full exposure of the pleural cavity has been secured by raising of a rib, preferably the fourth rib, and the debridement of the wound by a proper "separator" The situation, number and character of the adhesions between the visceral and parietal pleura are then observed, they are broken down with the finger. If the cavity is infected, it is necessary to put in a series of Carrel tubes for the purpose of disinfection

Second step Chemical Disinfection—This must be carried out with extreme care In cases of bronchial fistulæ, however, it is not well borne. Throughout the period of disinfection the pulmonary inspection is continued daily and methodically. The pleural cavity is measured by the quantity of liquid which can be injected into it, and the rise and fall of the lung is calculated very easily by the difference in volume of the liquid which can be injected during inspiration and expiration.

As soon as the daily bacteriological examinations of the secretions show that sterilization has been obtained (one organism or less in four fields), the thoracic orifice is closed. Before the closure is effected, it is prudent to suspend the antiseptic treatment, remove the tubes and apply a dry dressing to the wound left in position for twenty-four hours. Then three successive swabs are taken from the depths of the wound, from the edges of the wound and from the neighboring skin. If all three remain negative, the sterility of the wound is assured and the wound should be sutured.

Third step Partial or Total Decortication—When exploration and inspection show the presence of dense, false membrane binding down the lung, the false membrane is attacked at the point of the union of the lung and the chest wall. To do this an opening in the chest wall must be made, large enough to make the manipulation, facile. As soon as an entry has been effected between the membrane and lung, for which a bistoury has been used, the false membrane should be peeled back by a suitable spatula. The lung is then seen to begin to expand throughout the pleuro-costal groove

The pulmonary decortication is then proceeded with, beginning at the outside and proceeding toward the interior, either by median, transverse or longitudinal incision. In certain cases this peeling off can be effected throughout the whole surface and the lung may be seen to expand out of its shell and fill the thoracic cavity. In some cases the decortication may be completed without more serious injury to the surface of the lung than some erosion. When such simple decortication is not possible, the false pulmonary membrane must be removed en bloc from all points where it can be separated from the lung without too much tearing. At other points where it is too adherent, it must be thinned down. If absolutely firm adhesions are found, they should be abandoned, as entire pulmonary dissection is too dangerous.

If, a bronchial fistula is discovered, it should be closed after the method of Lembert The parietal reflection of the pseudo-membrane may be removed, if it comes away easily, otherwise, it may be left without any inconvenience

Fourth step Closure of the Wound—If on termination of the operation the whole of the decorticated surface after simple compression remains dry, the parietal wound should be closed by two rows of stitches. If there is profuse sanguinary oozing from the decorticated surface, a partial closure only of the wound is made and a light gauze dressing to absorb and effect the discharge is placed on the surface of the lung and brought out through the wound. This is left in place for twenty-four hours, after which it is removed and the suture completed.

It is seen that in these methods the tendency of surgery is exactly contrary to that which formerly prevailed. The thorax cage no longer takes the place of importance before the lung, the lung must always be considered before the chest wall. The advantages of methods now in vogue are considerable as regards the functional future of the patient. The lung resumes its normal activity, whereas in the old methods of treatment everything tended to destroy it

The final results in acute cases give a normal respiration unless at the base of the lung the diaphragmatic costal sinus disappears. In chronic cases the deformation of the thorax remains stationary after one has begun the treatment of the patient After cicatrization, the side affected of the thorax dilates and the respiratory capacity increases

OPERATIVE RESULTS OF EARLY SURGICAL TREATMENT OF WOUNDS OF THE LUNG

DR PIERRE DUVAL, Consulting Surgeon of the Seventh Army, said that for the last two years he had treated wounds of the lungs presenting serious immediate accidents, external or internal bleeding and opened thorax, by immediate surgical operation on the wound of the lung. For the past year and a half he had operated systematically on certain wounds of the chest to remove foreign bodies (missile, splinters), to clean surgically the wound of the lung (excision, sweeping suture), to clean the pleura and to treat the wound of the chest wall

Previous experience accumulated in this war, based on 3453 cases, warranted the statement that, without any immediate surgical treatment, the average total mortality of chest wounds reaches 30 per cent, not including soldiers who die before coming under surgical care The mortality of through-and-through wounds was 212 per cent, of wounds that retained shell fragments, 303 per cent, of wounds with opened thorax, 27 per cent, wounds with closed thorax, 15 per cent

Doctor Duval's personal statistics of last year were 161 cases, which included all cases from the field ambulance to the evacuation hospital, all the cases who died without having been operated, all those operated upon for serious bleeding or opened thorax, all those operated systematically and those not operated. Of the entire number twenty-seven died, a mortality of 167 per cent

Of the twenty-seven who died, thirteen were not operated upon They died soon after reaching the ambulance in such bad state that nothing could be done to save them

Of the remaining 148 cases who could be treated, fourteen died, mortality, 105 per cent. Among these 148 cases, twenty-nine were operated upon in conditions of urgency, either because they were bleeding severely—sixteen cases, nine deaths—or because the thorax was opened—thirteen cases, four deaths, mortality, 448 per cent.

Of the remaining 119 cases, 102 were treated medically, because there was no indication for operating. Of these, five developed empyema, with one death, the only death among the 102 cases. The remaining seventeen cases which presented no urgent indication for operation, but which, according to the speaker's experience, would probably have developed infection, were for this reason operated upon immediately after reaching the ambulance, indications for operating being given either by the size of the missile or the injury of the chest wall, fracture of ribs or scapula, or the extent

of the intrathoracic bleeding. This prophylactic operation consists in removal of the foreign body, direct treatment of the wound of the lung, removal of blood from the pleural cavity and careful incision of the chest wall

The results in these seventeen cases were no mortality, twelve complete healings, with six perfect and six very good results. Five cases developed complications, namely, three localized empyema (anaërobic bacilli), one developed an empyema of the general pleural cavity containing streptococci, one developed an abscess of the lung. These five cases healed well after a secondary operation had been performed

In the speaker's opinion, these complicating infections were due to the fact that the wound of the lung had not been sufficiently thoroughly treated, that is to say, incomplete excision, bits of clothing or splinters remaining in the wound or in the pleura and the missile not removed. All operated cases were looked after clinically every day. Exploratory punctures were done repeatedly to test the fluid bacteriologically. Every four or five days, or more often if necessary, a radioscopical examination was done at the bed of the patient with the mobile X-ray

In most cases the pneumothorax had disappeared after five or six days and the lung was in close contact with the chest wall. There remained during an average of from fifteen to thirty days a little shadow diffused through the whole lung or localized in one or two places, often in the lower part of the pleura. If there was some fluid, it often disappeared in eight or ten days. It was evacuated as soon as possible when necessary. In most cases thus treated the chest was normal on an average of from fifteen to thirty days, that is, the dilation of the thorax was normal and the movement of the diaphragm completely free. In six cases there remained a slight general opacity of the side, due probably to thickening of the pleura

If there is infection, it is usually a mild infection. There may be one or two localized pockets in the pleura. Serious generalized infection of the whole pleural cavity should be exceptional

In general, the impression gained from these cases is that the quality of the healing in these operated cases had been much better than when primary operation had not been done in similar cases

## SKIN LESIONS PRODUCED BY MUSTARD GAS-

- I DICHLORETHYLSULPHIDE (mustard gas) is an escharotic, specific in its action upon the epidermis and tissues of corium, particularly upon the endothelium of the vessels
- 2 The lesion is a chemical burn unlike that produced by heat, electricity, or the ordinary corrosives, such as sulphuric, nitric, and hydrochloric acids or strong alkalies. Of all these agents, the effects are most closely allied to those of hydrochloric acid, but are much greater in intensity. It differs from a heat burn in the absence of thrombosis, in the greater degree of fluid exudation, in the greater moistness of the affected area and in the fact that the necrosis as shown by the loss of nuclei requires hours, or even days, for its complete development. The coagulated, shrunken and cooked appearance of the tissues in heat burns is not apparent in the tissues of mustard-gas burns.
- 3 The vessels in the affected area are severely damaged and collapsed and there is a local animia in the earlier stages, with a marked fluid evudation and leucocyte migration. The process is non-hemorrhagic and non-thrombosing
- 4 In man the necrosis of the epidermis is usually evident in two hours through the hydropic change in the epithelium and early vesicle formation. There is no deep cedema. It is confined to the epidermis and to the papillary layer in the early stages.

<sup>\*</sup> Alfred Scott Warthier and Carl Vernon Weller in The Journal of Laboratory and Clinical Medicine, vol 111, No 8, May, 1918

- 5 In animals the intense and deep cedema is most striking and altogether different from that seen in man. Vesicle formation was not noted by us in animals
- 6 The deep penetration of the smallest quantities applied to the surface is a most striking feature. There is an undoubted entrance through the hair follicles, sebaceous and sweat glands
- 7 The slowly progressive character of the necrosis is a specific characteristic, the height of the necrosis being reached five to ten days after application. This may, in part, be explained by contraction and death of the vessels with resulting anæmia in the affected area.
- 8 The painlessness of the lesion is also a marked characteristic. This may be explained by the ædema and degeneration of the nerve endings in the affected portion
- 9 In none of our animals was there any conjunctivitis or irritation of the respiratory tract produced by the cutaneous applications. We conclude that there is no evidence of metastasis from the local lesion as claimed by both Meyer and Haldane. We believe that the conjunctival and respiratory lesions are due alone to the direct action of mustard gas, and when animals are protected from the vapor no lesions in these organs will result, no matter how severe the skin burn
- To Contrary to the statements of certain English and French observers, the admixture of water does not increase the escharotic action, but if the oil is immediately washed away, the lesion is greatly reduced in intensity. Washing within two minutes with tincture of green soap may entirely prevent the lesion or result in only a slight hyperæmia
- II We believe that the lesions observed in the axilla, between the fingers and toes, around the genitals and between the thighs of men gassed in action are probably due to the greater moisture of these parts from perspiration and the resulting re-solution of the gas
- 12 The slow healing is probably chiefly due to the vessel injury and the relatively slight leucocytic demarcating infiltration. In this respect the lesion is strikingly like an X-ray burn of the skin

# **BOOK REVIEWS**

Anatomy of the Human Body By Henry Gray, FRS Twentieth edition Thoroughly revised and re-edited by Warren H Lewis, MD, Professor of Physiological Anatomy, Johns Hopkins University Large octavo, cloth, pages, 1396 Lea & Febiger, 1918

For two generations American physicians and surgeons have been brought up on Gray's Anatomy The first English edition was published in 1858, and the following year appeared the first American edition. From time to time during the years that followed new editions have appeared. In each successive edition new knowledge which had become the possession of the profession was embodied. The original plan of Henry Gray, however, as regards presentation of the subject has been adhered to. The reviewer, who began his medical study with the first edition of Gray's Anatomy, as he opens this copy of the twentieth edition, realizes that it is the same book, although enlarged and sublimated, but in all essentials the extremely practical book which gave it so great success upon its first appearance and which has kept it a favorite among medical students even to the present day

Text-books upon human anatomy have abounded during these years since the first edition of Gray was published. Hyrtl, Braune, and Sabotta, in Germany, Sappey and Tillaux, in France, and Quain and Cunningham, in England, are examples of the laborers and authors in the field of anatomy during this period in their respective countries. In America, also, the activity in this field of labor has been noticeable. The volumes of Harrison, Allen, of Piersol, and of Gerrish are monuments of industry most creditable to American medicine, and the volumes devoted to surgical anatomy, clinical anatomy and applied anatomy by such men as Deaver, McClellan, Woolsey, Campbell, Eisendrath, and Davis show the zeal and thoroughness with which the practical applications of anatomical teaching have commanded the interest of American surgeons.

Each one of the anatomical treatises mentioned has its special features of value, and might readily be supposed to have lessened very much the interest in the old standard work which supplied the needs of the medical students fifty years ago. That such, however, has not been the case, and the text-book of the fathers still remains the favorite text-book of the sons, is due to the fact that in the repeated editions and enlargements for the introduction of new matter which has characterized the successive editions as they have appeared, the peculiar features of the original work have been retained

In the present edition it may be noted, in particular, that the sections on the ductless glands and the nervous system have been largely rewritten, a task for which the present editor was eminently fitted

### BOOK REVIEWS

THE ACTION OF MUSCLES Including Rest and Muscle Re-education By WILLIAM COLIN MACKENZIE, M.D., FRCS Octavo, cloth, pages, 267 New York Paul B Hoeber, 1918

The object of this little book, which may be read through at a sitting, is to call attention to the importance of a proper appreciation of muscle function, with special reference to a more intelligent and successful application of treatment to overcome losses of muscle power following traumatisms and the various paralyses—It is largely based upon observations made at the Military Orthopædic Hospital, Shepherd's Bush, London, of the staff of which the author is a member

Its careful reading will well repay any practitioner who has to do with the class of injuries involved, which practically means every medical man, for no class of injuries are of more frequent occurrence than those which form the theme of this study

Especially noticeable are the views of the author upon the subject of muscle rest He starts with the theorem that the muscle is a part of the nervous mechanism, that the motor nerve and the muscle are functionally interdependent Both the nerve and muscle are best considered as parts of an original unit, the muscle retaining the power of contractibility for producing motion, and the nerve retaining the power of irritability and of conduction The practical importance of this relation, too often overlooked, appears at once In such a disease as poliomyelitis, for instance, where the chief trouble has fallen on the anterior cornual cells of the cord, it is accepted as axiomatic that such cells should be placed at rest, if the inflammation of which they have become the subject is to be most successfully treated secure this rest of the anterior cornual calls, is is clear that, primarily, absolute rest of the muscles to which they are related shall be ensured, for with constant irritation of the muscle by faulty position, massage and electricity, the utmost is being done to prevent recovery of the inflamed nervous elements

Not only is muscle rest the most effective agent for repair of injury or inflammation of either the muscle itself or of the nervous elements with which it is connected, but the position of rest is the physiological basis for the re-education of muscle function

The author emphasizes the principle that, in the injury of a limb, as from a bullet or shell wound, the first care, apart from antisepsis, etc., of the wound itself would be the immobilization of the muscles. The immediate protection of the muscles by effective rest is fundamental in the treatment of injury of the limb

This naturally leads to a discussion of what constitutes muscle rest In determining this, it is important to take into consideration the state of the opposing muscles, and gravitational force as well, for a weakened muscle must not be allowed to be stretched and irritated by the contraction of its opponent, nor must the weight of an unsupported limb be allowed to exercise a constant dragging on a weakened muscle. Each muscle and

## **BOOK REVIEWS**

group of muscles, therefore, becomes the subject of especial study in the therapeutic application of this principle, and to the application of this principle to the different muscles of the body the greater part of the book is devoted. For it is by position with adequate immobilization that the deformities of limbs produced by chronically contracted muscles working against weakened opponents are to be overcome. Thus deformities due to muscle weakness may always be prevented.

The author condemns positively brisement forcé In his view, the breaking down of muscle contraction, like the "smashing up" of joint adhesions at one sitting under an anæsthetic, cannot be too vigorously condemned By such procedure permanent injury is usually done to the muscle

We commend the study of this little book to all surgeons

# CORRESPONDENCE

# IODINE AS A SKIN DISINFECTANT PREVIOUS TO INTRA-ABDOMINAL WORK

To the Editor of the Annals of Surgery

The keynote of a question is not always easy to strike, even by one qualified to speak. No better illustration of this has come to my notice than a letter published in the Annals of Surgery for September, 1918, over the signature of A. Ernest Maylard, of Glasgow. The author of this letter would warn us against the "dangerous practice" of sterilizing the abdominal skin by the use of iodine, and substantiates his contention by quoting from a letter recently published in the Annals of Surgery by Doctor O'Conor, and also from some experiments conducted on dogs by Propping and others

Doctor Maylard's letter may contain an element of truth, but it is so conspicuous in another element that it should not pass unnoticed. The author of this letter staits out to tell us about iodine as a means of sterilizing the skin, when suddenly he departs from this subject to regale us with the subject of intra-abdominal adhesions, leaving us to guess, perhaps, that between the two there may be some mysterious relation, or that the one is dependent in some way on the other

Doctor Maylard is probably correct in not denying that iodine will sterilize the skin, just as it is correct to state that when iodine is loosely splashed and spilled about over the abdomen, and carried by every stroke of the surgeon and his assistants, by sponges and instruments, to all parts of the abdominal cavity during an hour or two's duration, it will carry with it an element of danger, and leave behind it, as Doctor Maylard rightly says, many dangerous adhesions within the abdomen

The letter is quite incorrect when it states that iodine is a "veritable death trap," and as a means of sterilizing the abdominal skin is a "dangerous practice" Years of surgical work by thousands of surgeons in civil and military surgery alike have given to iodine a safe place as a therapeutic agent, one which leaves little to be desired in cheapness, promptness and effectiveness in fulfilling the purpose for which it is used safe, satisfactory, and dependable always. Iodine employed on the abdommal skin in the manner below described will render it fit for the surgeon's work under practically all conditions It is free from danger, and results in no damage, immediate or remote, temporary or permanent, to the tissues or structures within the abdomen The uncovered and unprotected iodinized skin during any operative procedure is a gross neglect, a glaring defect in surgical technic, and is fraught with danger. The proper use of iodine is safe, it's abuse is not safe. The same may be said of any antiseptic,

## CORRESPONDENCE

even of carbolic acid, the most dangerous and unreliable of all antiseptics, and to which Doctor Maylard's faith is still clinging

Iodine spread liberally upon the abdominal skin as strong as 7 per cent will effectively sterilize it under all conditions. After making the incision through the skin thus sterilized, the iodinized surface is covered with sterile towels, which are accurately fastened into the skin or wound margins, preventing in this manner any of the iodine, by the operator's manipulations, from entering the abdominal cavity while the operation is going on. These towels are not released until the operative work within the abdomen is finished and peritoneum closed. When the towels are removed the skin shows the same deep iodine stain, proof that it has not been mopped up and carried with every move of the operator into the abdominal cavity, where harm may be done

In this day of rapid and ever-changing therapeutic measures, as well as operative procedures, a few things have come to stay, have stood the test of time and experience, and are relied on by most men Iodine, as a means of skin sterilization, is one of these

With communications such as this, and the one to which it makes reply, should go our humble apologies to the editors of the medical journals, as is here intended, for requesting space and time sufficient to publish that which time has long since fully established and thoroughly settled, and which should not at this late day call for further elaboration, but should make way and room for better things

WILLIAM 'FULLER,
Major, M C, U S Army .

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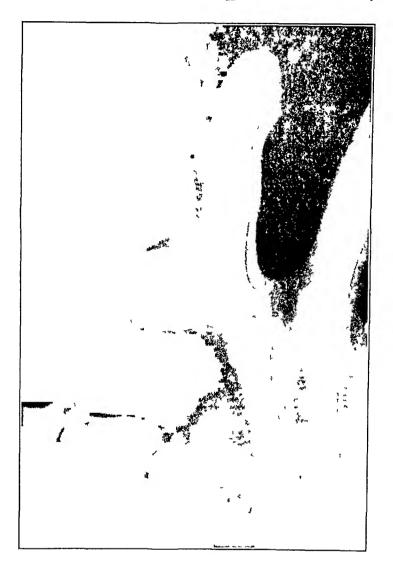
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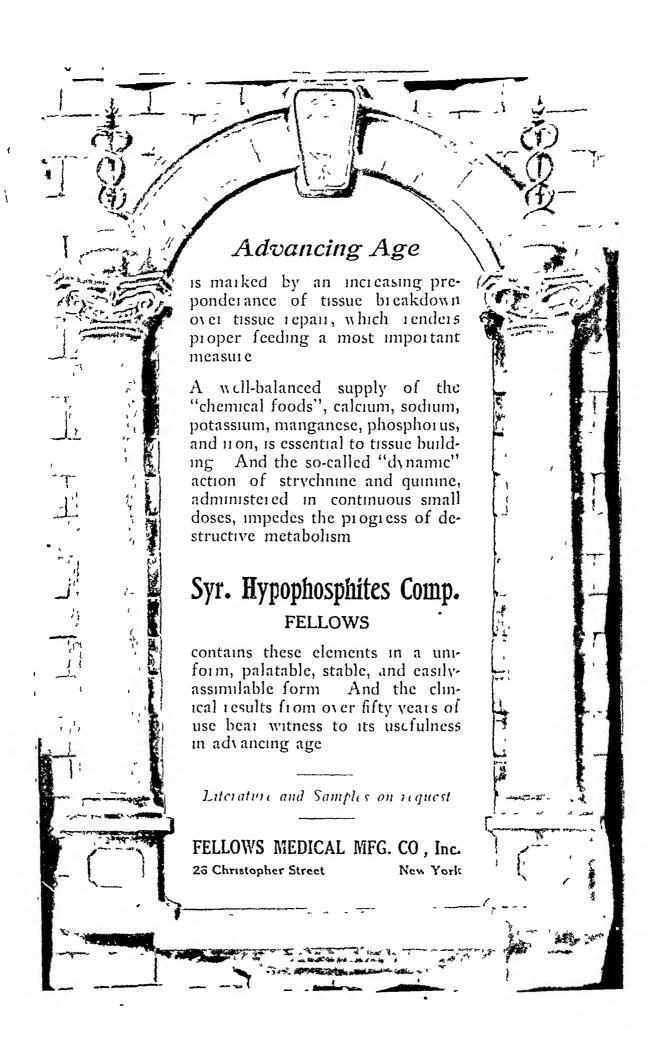
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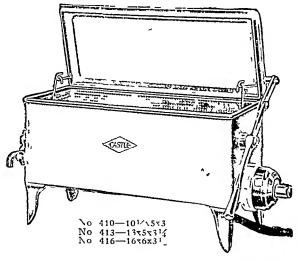
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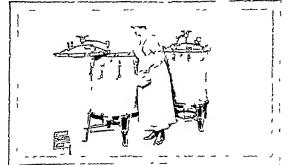
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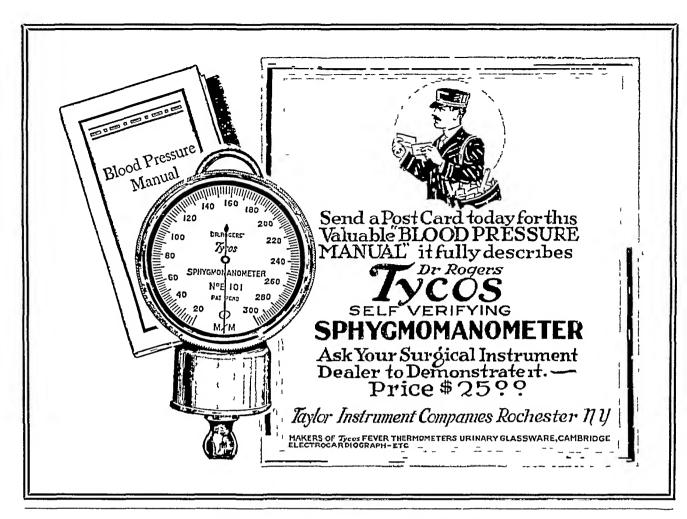
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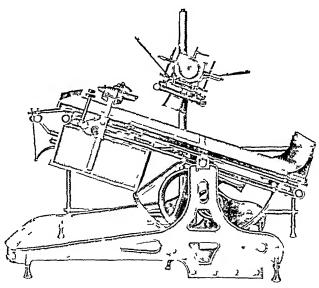
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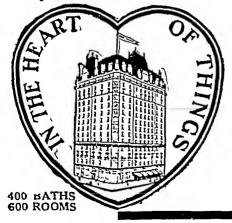
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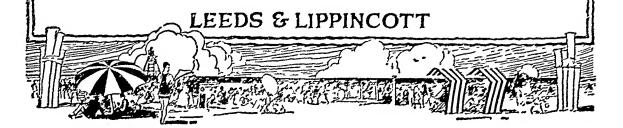
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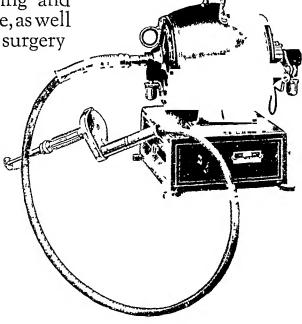


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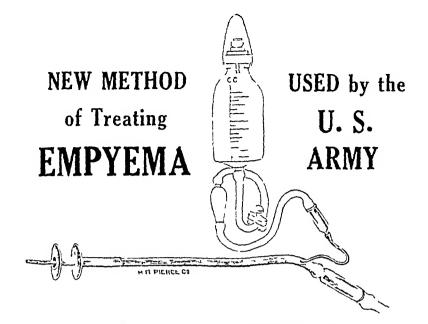
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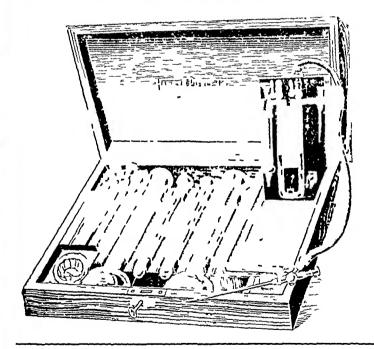
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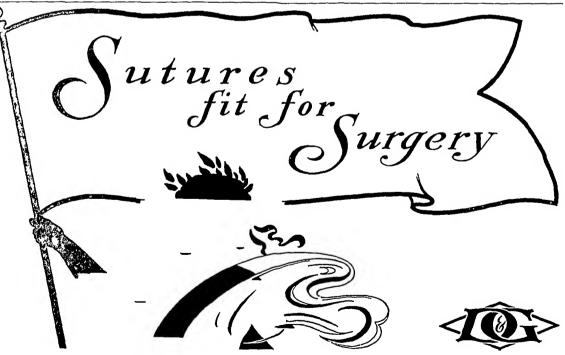


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# ANNALS of SURGERY

Vol. LXVIII

DECEMBER, 1918

No 6

# EXTIRPATION OF THE CHOROID PLEXUS OF THE LATERAL VENTRICLES IN COMMUNICATING HYDROCEPHALUS

By WALTER E DANDY, M D.

OF BALTIMORE, MD

(From the Department of Surgery, The Johns Hopkins Hospital and University)

No form of treatment, either medical or surgical, has yet a valid claim to the cure of a single case of hydrocephalus, except in those cases caused by tumor and relieved by tumor extirpation. But hydrocephalus is a curable disease. This is demonstrated by the not infrequent cases which have been cured spontaneously, though usually at a time when cerebral destruction has left the patient a hopeless imbecile. The reason for nature's successes is that the cause has been either circumvented or overcome. The reason for medical or surgical failures is that the cause has not been recognized. All forms of theiapy have been entirely empirical. They have been directed toward the effect rather than the cause. They have lacked not only the etiology and pathology of the disease but even a knowledge of the circulation of cerebrospinal fluid before pathological changes have occurred

Hydrocephalus should no longer be classified as an idiopathic disease. Its pathology and, in large part, its etiology are definitely established. With the cause recognized, a rational form of therapy is indicated. I make this statement principally upon the results of our own investigations, which have been conducted in the past five years. These studies include the paths for the circulation of cerebrospinal fluid, the place and manner of formation and absorption of cerebrospinal fluid, the experimental production of hydrocephalus, the pathogenesis of many cases of hydrocephalus studied clinically by the phenolsulphonephthalein test, and the pathology of the various so-called types of hydrocephalus by post-mortem examination. The present communication is directed to the treatment based upon these observations

A knowledge of the type of hydrocephalus is an absolute prerequisite to its treatment. The timeworn symptomatic classifications are incoordinate and confusing. The classification on the following page is presented, based upon the etiology and pathology of the disease.

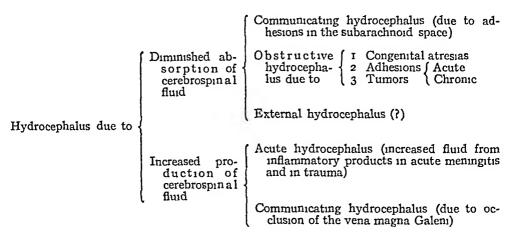
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<sup>&</sup>lt;sup>1</sup> Dandy, W. E., and Blackfan, K. D. Internal Hydrocephalus. An Experimental, Clinical, and Pathological Study. J. Am. M. Assoc., 1913, lx1, 2216, Am. J. Dis. Child., 1914, viii, 406, Beitr. z. klin. Chir., 1914, xciii, 392. Internal Hydrocephalus, Second Paper. Am. J. Dis. Child., 1917, xiv., 424.

#### WALTER E DANDY

The vast majority of cases of hydrocephalus are included in one of the two groups (1) Communicating hydrocephalus, (2) obstructive hydrocephalus. The other types are rare. It will be noted that no separate subdivision has been made into internal and external hydrocephalus. It is a question whether external hydrocephalus ever really exists as a primary condition. It seems to be a secondary transformation of a primary internal hydrocephalus. This metamorphosis is probably due to a local or general atrophy of the cerebrum permitting escape to the exterior by these artificial channels. Because of the rarity of this condition, however, our facts are not sufficient to make a positive stand in this statement. It is conceivable, though not proven, that it may also result from a transfer of cerebrospinal fluid from the subarachnoid space to the subdural space in communicating hydrocephalus. The exact status of so-called external hydrocephalus is still in doubt. With this rare exception, nearly all hydrocephalus is internal, that is, the accumulation of cerebrospinal fluid is in the ventricles. It is internal for the very



good reason that cerebrospinal fluid forms in the ventricles and cannot reach the exterior (obstructive hydrocephalus), or at most it reaches only a small fraction of the external absorbing surface—the posterior cranial fossa and spinal canal (communicating hydrocephalus). In either case the fluid dams back at its source. If cerebrospinal fluid could reach the subarachnoid space over the entire exterior of the brain, it would be absorbed and hydrocephalus could not exist.

Another rare type of hydrocephalus is that due to thrombosis of the vena magna Galeni. Owing to insufficient collateral venous circulation, hydrocephalus then results from an increased production of cerebrospinal fluid by venous stasis, just as ascites often follows stenosis of the inferior vena cava. I have produced this type experimentally, but have seen no instance clinically. Only a few cases have been reported in the literature

In acute meningitis of inflammatory origin there is undoubtedly an increased production of fluid from the products of the inflammation. It is questionable whether an increase of fluid by exudation should be classified

#### EXTIRPATION OF THE CHOROID PLEXUS

with true hydrocephalus It is probably external as much if not more than internal, because the infection has a general but principally external distribution. It subsides with the decline of the infection and is not of practical import in considering the treatment of hydrocephalus. An increase of fluid also follows trauma to the brain in fractures of the skull. It is probably of vascular origin, and usually subsides rapidly

Fundamentally the two main types of hydrocephalus—obstructive and communicating—are similar—Both are due to an obstruction in the cerebrospinal fluid circulatory system—In our series of cases in children the relative frequency is nearly the same—In the former the obstruction is in the ventricles and in the latter in the subarachnoid space—The only reason for subdividing hydrocephalus into groups is that the anatomical differences in the two types necessitate an entirely different operative procedure for the treatment of each

In this paper only the treatment of the communicating type of hydrocephalus will be considered. A form of treatment for hydrocephalus with obstruction will be presented in a later communication. For a proper understanding of the basis for the operation herein proposed, a brief explanation of the underlying etiology and pathology is necessary.

The Etiology and Pathology of Hydrocephalus with Communication—
It is the communicating type of hydrocephalus which has caused all hydrocephalus to be considered idiopathic. Though numerous explanations have been proposed, no pathologic findings have been presented until recently All the ventricles communicate with each other and with the subarachnoid space, and post-mortem examinations of the brain have heretofore revealed nothing to the naked eye. The reason for the negative findings has been an inadequate knowledge (1) of the post-mortem appearance of the normal subarachnoid space and the pia arachnoid membranes, (2) of the alterations produced by pathological changes, (3) of the relation of the subarachnoid space to the absorption of cerebrospinal fluid, and (4) the anatomy and physiology of the cerebrospinal fluid circulatory system

The only satisfactory time to observe changes in the meninges is when the brain is being removed. Adhesions of an extensive nature will then be seen and divided, but later will show very little in the preserved specimen. In cases of communicating hydrocephalus the meninges will be opaque and thickened, the normal filmy pia arachnoid will be replaced by a firm, fibrous, adherent membrane. This will be especially noted in the disternance at the base of the brain. The adhesions are often so dense as to tear the brain during their liberation. It is the distribution or location of these adhesions, not their extent, which determines the production of hydrocephalus (Fig. 5). Adhesions encircling the midbiain where it passes through the incisura tentorii, will destroy all communication between the posterior and middle cranial fossæ and thereby eliminate the entire subarachnoid space over both cerebral hemispheres from participation in the absorption of cerebrospinal fluid Hydrocephalus will invariably result from such a process. Adhesions which

#### WALTER E DANDY

close the cisternæ at the base of the brain will also produce hydrocephalus just as effectively

The extraventricular cerebrospinal circulatory system may be compared to the trunk and branches of a tree—the cisternæ representing the trunk, the subarachnoid spaces over the cerebral hemispheres the branches. Obliteration of the cisternæ by adhesions is equivalent to transection of the trunk of a tree. All distal communication will be destroyed and hydrocephalus will follow. Large areas of adhesions may be present over the cerebral hemispheres with only local effects and with no effect upon the general cerebrospinal fluid circulation. This is analogous to the absence of a relationship between the destruction of branches and the life of a tree. The absorbing function of these local areas is easily compensated by the subarachnoid space over the remainder of the brain

In each of our cases these adhesions have also obliterated either one or two of the three foramina (Luschka and Magendie) by which the ventricles and the subarachnoid space normally communicate (Fig 5). One foramen remaining patent will maintain an adequate transfer of cerebrospinal fluid Should the adhesions close all three foramina at the base instead of only one or two, an obstructive hydrocephalus would result. In short, communicating hydrocephalus is due not to a reduction in the avenues of communication between the ventricles and the subarachnoid space but to a blocking of the primary trunks of the subarachnoid space, thus preventing cerebrospinal fluid from passing to the branches. The distribution of cerebrospinal fluid is thereby limited to that small part of the subarachnoid space in the posterior cranial fossa and the spinal canal. It does not include any of the subarachnoid space over either cerebral hemisphere, which is by far the most important area for absorption

Cerebrospinal fluid is absorbed from the entire subarachnoid space Adhesions obstructing the main stem of the subarachnoid space therefore limit the absorbing area to a fraction of the normal, and the diminished absorption results in accumulation of cerebrospinal fluid—hydrocephalus

We have spoken of adhesions almost exclusively as the cause of communicating hydrocephalus. It is conceivable that certain tumors filling or compressing the cisternæ may produce similar results. We have as yet no proof of this possibility. All of the cases observed by Dr. Blackfan and myself have had a meningitis, which has been both prenatal and postnatal. There is frequently a definite history of meningitis preceding the development of hydrocephalus, but this cannot always be obtained

Studies with the phenolsulphonephthalein test enabled us to predict ante mortem the pathologic findings. By the dye it was possible to measure the amount of absorption from any region by the quantitative excretion in the urine. It was found that normally practically no absorption occurs from the entire ventricular system (less than 1 per cent in two hours). All the cerebrospinal fluid is absorbed from the subarachnoid space, 40 to 60 per cent being excreted in a two-hour interval, which has been adopted as an

#### EXTIRPATION OF THE CHOROID PLEXUS

arbitrary standard of time. In a large series of cases of communicating hydrocephalus the absorption from the subarachnoid space was found almost invariably to be only 8 to 10 per cent, or about one-fifth of the normal

In view of the fact that experiments on animals have demonstrated that absorption of cerebrospinal fluid is from the entire subarachnoid space, the lowered absorption in communicating hydrocephalus must mean a reduction in the extent of the absorbing area and at a fairly constant location. The localization of the adhesions blocking the cisternæ or surrounding the mesencephalon harmonized the physiological and clinical tests and the pathological findings. The frequent history of an antecedent meningitis is additional confirmatory evidence, should such be necessary. The experimental production of this type of hydrocephalus by duplicating nature's pathologic processes, leaves no doubt of the etiological and pathological basis of communicating hydrocephalus. This experimental proof will shortly appear, together with that of the other types of hydrocephalus

In operations upon the brain of cases of communicating hydrocephalus, one is impressed by the absence of fluid in the sulci. The sulci are practically obliterated, and only vascular lines separate the convolutions. If hydrocephalus were due to occlusion of such fanciful structures as stomata into the venous sinuses or the Pacchionian bodies, as has been proposed, one should expect distended subarachnoid spaces up to the points of obstruction. The absence of extracerebral cerebrospinal fluid proves the non-existence of any such mechanism, and indicates the lack of communication of the part of the subarachnoid space with the fluid-containing spaces, in other words, an obstruction must exist at some place nearer the origin of the cerebrospinal fluid.

The Diagnosis of Hydrocephalus with Communication —Clinically, the two types of internal hydrocephalus are identical. Neither by the history nor the physical examination can they be differentiated. Frequently, the communicating type can be diagnosed by the large quantity of cerebrospinal fluid which can be obtained by lumbar puncture, but there is such great variability in the amounts of fluid obtained in both types of hydrocephalus that the results are frequently of little value. The differentiation between the two types of hydrocephalus can be simply, harmlessly and absolutely made by the phenolsulphonephthalein test.

One cubic centimetre of neutral phenolsulphonephthalein<sup>2</sup> is introduced into either lateral ventricle, a lumbar puncture is done one-half hour later. If communication exists, the dye will by that time have appeared in the spinal fluid. If an obstruction exists in the ventricular system, the spinal fluid will remain colorless. This test is the only way in which guess-work can be eliminated.

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<sup>&</sup>lt;sup>2</sup>This solution has been specially prepared by Mr H A B Dunning, of Hynson, Westcott & Dunning A serious reaction will follow the use of the ordinary phenolsulphonephthalein solution used for kidney studies

#### WALTER E DANDY

great number of operations suggested, tried, and found failures, their consideration individually would require too much space and yield little of practical value. With rare exceptions, no attempt has been made to differentiate the two types of hydrocephalus. The usual treatments have been directed toward a disposition of the fluid, (I) either by transferring the fluid to the exterior of the brain, to the scalp, the retroperitoneal space, the peritoneal cavity, or some other space, or (2) by making a communication with some part of the venous system, either directly or by a vascular transplant, (3) in addition to periodically repeated lumbar and ventricular puncture, attempts have been made to establish a more or less continuous drainage to the exterior, always, of course, with death from secondary infection. Other attempts have been made to reduce the formation of cerebrospinal fluid by ligating one or both carotid arteries, by injection of irritants into the ventricles, compression of the head, etc

All attempts to drain into body spaces are futile because the tissues wall off the fluid and soon cease to absorb it. Moreover, the openings into the spaces remain patent only temporarily. Puncture of the corpus callosum might at first sight appear to be an ideal procedure, but it is practically identical with punctures elsewhere. Fluid side-tracked by an opening of the corpus callosum or of other parts of the brain does not pass into the subarachnoid space, but into the avascular subdural space, where absorption is little if any greater than in the ventricles or in the scalp. Moreover, the opening in the corpus callosum or elsewhere closes in the course of a few weeks. Fluid can reach the subarachnoid spaces over the brain only through the normally designated distributing channels—the cisternæ. Permanent communication between the ventricles and the cisternæ can be maintained only through the fourth ventricle and by means of the foramina of Luschka and Magendie, or, in their absence, by openings artificially produced in this region.

The fate of vascular communications is similar. The opening into the veins, sinus or transplant functions but briefly. Such openings can hardly be expected to function properly, because they should handle in a few minutes all the fluid which is produced in several hours, and would be functionless the remainder of the time. Normal absorption of cerebrospinal fluid takes place slowly, by a process of osmosis through membranes and not into prepared openings or stomata.

Scientific Basis for Operative Treatment—The logical treatment of any disease is the removal of the cause. In communicating hydrocephalus the treatment of the cause, that is, the removal or liberation of adhesions, is precluded by present surgical limitations. The area of adhesions is too extensive, too diffuse, and in a location maccessible for operative interference. The ideal treatment would be restoration of the cisternæ through these adhesions, and even if reconstruction were possible reformation of the adhesions must always remain a possibility

In view of these deterring factors, treatment of the cause must for the

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present at least be deferred. From the results of experiments on animals a new and scientific form of treatment is suggested, by which it is hoped to circumvent the cause. This treatment aims to restore the balance between fluid production and fluid absorption by reducing the production of cerebrospinal fluid to a level where it can be absorbed. By experiments on animals, the results of which will appear shortly, the following facts have been established.

- (1) If the foramen of Monro is occluded, a unilateral hydrocephalus results;
- (2) But if the entire choroid plexus of this ventricle is removed at the time the foramen of Monro is occluded, this ventricle will be obliterated,
- (3) Therefore, cerebrospinal fluid forms from the choroid plexus, and not from the ependyma
- (4) Following total occlusion of the aqueduct of Sylvius the development of hydrocephalus is greatly retarded by the extirpation of the choroid plexus of both lateral ventricles. In this experiment the cerebrospinal fluid, which is produced proximal to the obstruction, can be derived only from the choroid plexus of the third ventricle.

The conclusion from these experiments is if all the choroid plexuses of the four ventricles could be removed, the formation of cerebrospinal fluid would cease and hydrocephalus could not result or if present its development would cease. To cure obstructive hydrocephalus by removal of the choroid plexus, it would be necessary to remove all of the choroid plexuses because there is no absorption in the ventricles, but in communicating hydrocephalus, there is about one-fifth of the normal absorption. It would not therefore be necessary to remove the entire amount of choroid plexus but to reduce its volume until the amount remaining would not produce cerebrospinal fluid faster than it could be absorbed. In other words, it would be necessary to remove roughly four-fifths of the total amount of choroid plexus to reduce the fluid formation to the 8 to 10 per cent absorption (one-fifth of the normal) which occurs in communicating hydrocephalus.

It is not feasible to remove the choroid plexus from the third ventricle and very difficult to extirpate flocculi in the fourth ventricle. Roughly the choroid plexuses of the combined third and fourth ventricles is about one-fifth of the total amount in all the ventricles. The plexus is in the two lateral ventricles therefore comprise about four-fifths of the total. It is relatively easy to remove the choroid plexus from both lateral ventricles. A bilateral extirpation from the lateral ventricles should, therefore, according to our present conceptions, reduce the formation of cerebrospinal fluid to a point where it can be absorbed by the restricted patent area of the subarachnoid space.

The problem, however, is not purely one of mathematics. Casually, one would expect that the removal of 75 per cent of the productive structure would reduce the formation to meet absorption which is 20 to 25 per cent

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of the normal, but it should do even more, for in hydrocephalus fluid is formed at a greatly reduced rate because of the changed intracranial pressure from fluid accumulation It has been demonstrated that the formation of cerebrospinal fluid is to a large extent at least mechanical easily be demonstrated by inducing venous congestion by compression of the veins of the neck We know that fluid forms at a greatly lessened rate in hydrocephalus due to the increased intracranial pressure, because if it formed at the normal rate (which we know) the head would grow at a tremendous speed Although nature can modify the rate of fluid production she is unable to reduce its formation to the level at which it can The removal of the choroid plexus from both lateral venbe absorbed tricles should be more than is necessary, but it seems preferable to remove too much with no consequent danger, than to run the risk of an insufficient removal, in which event a progressive destruction of the brain will inevitably Hydrocephalus even when developing at the slowest rate causes a rapid atrophy of the brain. It is of course obvious that if more than the necessary amount of choroid plexus is removed, extra- and intravascular pressure differences will produce sufficient fluid to maintain the necessary amount of fluid to fill the ventricles

The Operation <sup>3</sup>—The steps in the removal of the choroid plexus are clearly shown in the accompanying drawings by Miss Norris. A small circular bone flap is made over the parietal eminence (Fig. 6). The wound is made well posterior to the Rolandic area and in a salient part of the occipital lobe. After ligating numerous vessels on the cortex by circumvection, the cortex is bloodlessly incised and this incision carried into the ventricle. From the exposure which is over the junction of the body and descending horn of the lateral ventricle, the entire extent of the ventricle can be brought into view (Fig. 7). The opening in the brain is maintained by an open nasal dilator (Fig. 8), or when the ventricle is very large the brain wall must be elevated by a spatula which is inserted into the ventricle. It is necessary to remove all the cerebrospinal fluid in the ventricle to get a view of the choroid plexus, the brownish-red flocculent choroid plexus can then be easily followed from the foramen of Monro to the tip of the descending horn

The choroid plexus is picked up in forceps at the foramen of Monro (Fig 8), and the vessels ligated by a silver clip. A pledget of moist cotton is inserted into the foramen of Monro to prevent blood gravitating into the third ventricle. The plexus is then transected and gently stripped backward from its narrow attachment to the floor of the body of the ventricle. When the glomus is reached the stripping from the body of the ventricle is stopped and the choroid plexus picked up at the tip of the descending horn (Fig 9). This part of the choroid plexus is also stripped backward to the glomus, the remaining attachment of the glomus is then liberated and the entire choroid

<sup>&</sup>lt;sup>2</sup> I am greatly indebted to Professor Halsted for many suggestions in the development of this operative procedure, as well as in the experimental work upon which the operation is founded

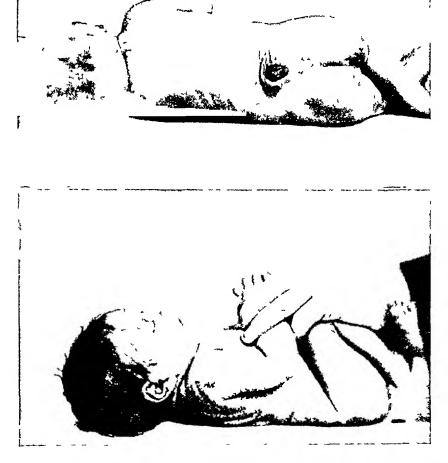


Fig. 1—Views of case of early communicating hydrocephalus with lumbar meningocele. The meningocelelwas removed and a bilateral extirpation of the choroid plexus of the lateral ventricles was performed in the first three weeks of life. The head is not enlarged. A most unusual diagnosis of hydrocephalus was made at birth by Dr. J. Whitridge Williams, because of the wide fontanelles and the meningocele.



Fig. 2—A ventriculogram of the case of communicating hydrocephalus shown in Fig. 1. A well-advanced hydrocephalus can exist even when the size of the head is normal



Fig 3 —Same child as Fig 1 eight months after the bilateral operation. The scar can be seen in the back of the head. The head is still of normal size. The size of the fontanelles is much reduced. The child is apparently perfectly well.



Fig. 4—Case of advanced communicating hydrocephalus. Beyond this stage the patient seldom survives any operative procedure. This patient died three weeks following the removal of the choroid plexus of one lateral ventricle.

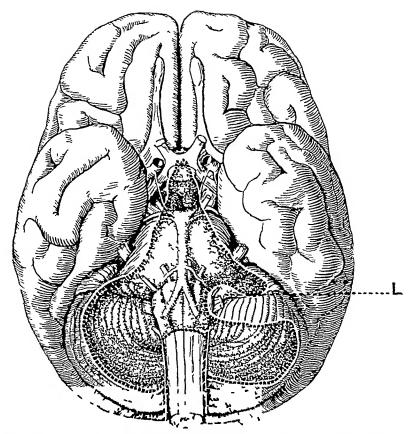


FIG 5—Diagram to show the distribution of adhesions over the base of the brain in a case of communicating hydrocephalus. All the cisternæ are obliterated. Communication between the ventricles and subarachnoid space is restricted to one foramen of Luschka (L). The other foramen of Luschka and the foramen of Magendie are sealed by the adhesions. Ablation of the cisternæ prevents cerebrospinal fluid reaching the cerebral subarachnoid space.

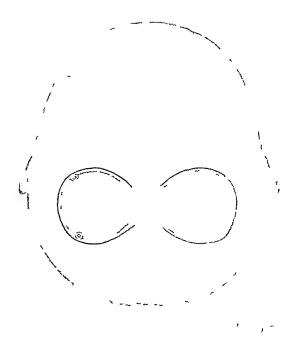


Fig 6—Shows location shape and size of incision in scalp and bone for bilateral extirpation of choroid plexus of lateral ventricles. The solid line marks the skin incision, the dotted line the bone flap which is broken and reflected at the base

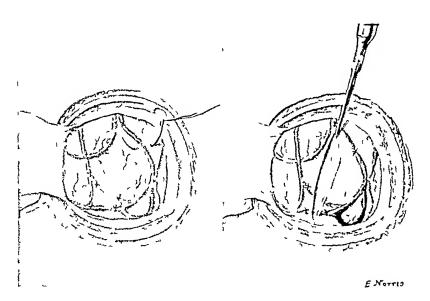


Fig. 7—Shin bone and dura are reflected. The cerebral vessels are doubly lighted with fine silk by circumvection. Between these two rows of sutures the cortex is incised with the scalpel and this incision carried through to the ventricle

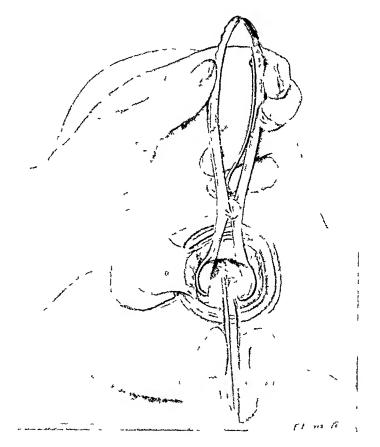


Fig. 8 —The opening in the cortex is maintained by a nasal dilator. Through this opening the choroid plexus is removed in the manner shown in Fig. 9. The fluid has been entirely removed from the ventricle to permit exposure of the choroid plexus.

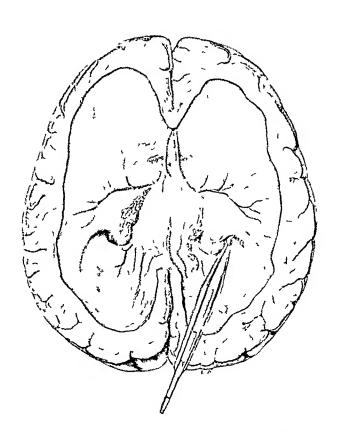


Fig. 9—Coronal section through hydrocephalic brain showing method of stripping choroid plexus from its attachment to the floor of the ventricle. The right plexus has been stripped from the foramen of Monro to the end of the glomus and at the tip of the descending horn is shown grasped by the forceps in the process of being stripped to the glomus. The entire plexus is then lifted from its bed



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plexus removed in toto Bleeding from the denuded area of velum interpositum is slight and easily controlled by moist saline cotton pledgets. Special care must be taken to leave no bleeding points

The collapse of the brain following evacuation of the ventricular fluid causes a remarkable infolding of the cerebral walls, the extent depending of course upon the size of the ventricle and thickness of the cortex. In advanced cases a tremendous cavity results, which is filled before closure with salt solution to restore the collapsed cerebral wall as nearly as possible to its natural convexity.

A remarkable exposure is obtained during the operation in the ventricle One can see the third and opposite lateral ventricle and the septum lucidum which is frequently perforated in many places owing to pressure atrophy

The opening in the cortex is closed with a series of interrupted fine silk sutures which are held by the delicate pia arachnoid membrane. The dura and scalp are carefully closed also with silk, special care being taken to prevent any subsequent leak of cerebrospinal fluid.

Result —I have extirpated the choroid plexus in four cases of hydrocephalus from Professor Halsted's Clinic All of these have survived the operation, although three died two to four weeks after the operation One patient has survived a bilateral choroid plexectomy ten months, and shows no evidence that the disease is advancing During and following the operation the reaction seems to vary directly with the grade of the disease ventricle is small the operation will be well tolerated even by a very young When the ventricles are large and the cortex is greatly thinned and marked enlargement of the head has resulted, a very severe reaction occurs during the operation and the convalescence is very slow. In the highest grades of hydrocephalus death will follow almost immediately upon release of the fluid, or a very severe reaction will result at once and death will quickly follow In the advanced cases we can hold out very little encouragement from operative procedures of any kind which will necessitate release of fluid and consequent collapse of the brain There is, however, little object in attempting a cure of the disease in this advanced stage because the child would be left a hopeless imbecile. In the three cases of this series which subsequently died the hydrocephalus was of the extreme grade of these there was an immediate operative collapse, beginning with pallor of the face and body, rapid feeble pulse which quickly becomes imperceptible, cold clammy perspiration, 1apid, shallow and 1rregular respirationsin other words, typical shock These changes invariably begin with evacuation of ventricular fluid, and are undoubtedly due to differences of pressure which affect all the blood-vessels and directly or indirectly the centres Following escape of the fluid the thin brain walls collapse in the medulla In addition to the differences in intra- and extravascular like a wet cloth pressures, the mechanical kinking of the large vascular trunks by angulation of the infolding brain must have a pronounced effect upon the circulation

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In each instance there was a gradual recovery, and death came from two to four weeks later. In two cases death was no doubt due to gradually progressive acute intracranial pressure which we now would be able to recognize and probably alleviate. In a third case the cause of death is still uncertain, though undoubtedly a result of the operation. The temperature rose to 108° four hours after operation, remained around 102° to 106° for two weeks. Though conscious, the ability to swallow was lost and not regained. At autopsy no cause for death could be observed.

In the fourth case, which is still living and well and with no evidence of progress of the disease, no post-operative effects were observed, despite the fact that within three weeks of birth three operations were performed, one for the removal of a large myelomeningocele and two for the bilateral extirpation of the choroid plexus. Feeding was uninterrupted, the temperature at no time rose over 100°, and the rising curve of body weight was not even temporarily affected.

This case was kindly referred to me by Dr J Whitridge Williams, who made a most unusual diagnosis of hydrocephalus immediately following the child's delivery in his clinic. The head was not enlarged but the fontanelles were wider and a trifle fuller than normal (Fig I). The myelomeningocele also suggested the possibility of hydrocephalus. A ventriculogram4 showed a well developed hydrocephalus with complete obliteration of the posterior horn of the lateral ventricle (Fig 2). In no other way could this very early tentative diagnosis have been substantiated

Unfortunately in this case our diagnosis of communicating hydrocephalus has been to a large extent conjectural. The large myelomeningocele filling the lumbar region precluded successful lumbar puncture, so that we were unable to determine by the phenolsulphonephthalein test whether communication was present, or indirectly by quantitative absorption whether the hydrocephalus was of the communicating type

The absorption of phenolsulphonephthalem following injection into the venticle was 2 per cent, which is a little higher than in obstructive hydrocephalus and about what obtains in communicating hydrocephalus. This is not considered conclusive by any means, as the difference between the ventricular absorption in the two types of hydrocephalus is not great enough to be a decisive test. The meningocele is by no means evidence in favor of a communicating and against an obstructive hydrocephalus.

Wherever possible both choroid plexuses should certainly be removed. This requires two operations, the length of time intervening depending upon the reaction following the first operation. Only one of our cases has had a bilateral extirpation. It is doubtful whether the removal of the choroid plexus of one ventricle would produce more than a retardation of the disease, which, of course, would be of no ultimate benefit.

Dandy, W E Ventriculography Following the Injection of Air Into the Cerebral Ventricles Ann Surg, July, 1918

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Even though one case is apparently well ten months after a bilateral extirpation (Fig 3), no conclusions are justifiable on the basis of a single case or in such a short period of time. The operation is presented without claims of cure, but because of its apparently sound scientific foundation it is hoped and expected that cures will result

#### CONCLUSIONS

- I Any treatment of hydrocephalus must be based upon the etiology and pathology of this disease
- 2 Communicating hydrocephalus is caused by an obstruction in the subarachnoid space causing diminished absorption of cerebrospinal fluid
- 3 This obstruction is probably nearly always due to adhesions following meningitis
- 4 These adhesions close the cisternæ through which all cerebrospinal fluid is distributed to the subarachnoid space over the cerebral hemispheres
- 5 Absorption is reduced to one-fourth or one-fifth of the normal, roughly corresponding to the volume of subarachnoid space which contains cerebrospinal fluid
  - 6 It is at present impossible to reestablish the cisternæ by surgical means
- 7 By experiments it has been demonstrated that cerebrospinal fluid forms from the choroid plexus
- 8 An operation is presented for the cure of this type of hydrocephalus by removal of the choroid plexus of both lateral ventricles. This removes, roughly, four-fifths of the total amount of fluid-forming structures. It is hoped the cerebrospinal fluid which forms from the choroid plexus can be absorbed in the small amount of subarachnoid space which remains in the third and fourth ventricles.
- 9 Choroid plexectomy is of value only in communicating hydrocephalus Any treatment therefore presupposes an accurate diagnosis of the type of hydrocephalus This is best made by the phenolsulphonephthalein test
- 10 The operation has been performed on four cases. One case is alive and apparently well ten months after the operation
- II Sufficient time has not elapsed to speculate on the practical results of the operation
- 12 The operation can be safely performed in moderately advanced cases of hydrocephalus

#### RIB CARTILAGE TRANSPLANT FOR SADDLE-BACK NOSE\*

#### By Penn G Skillern, Jr, M D of Philadelphia

Case I — Male, white, aged twenty, clerk, who fifteen years previous to admission suffered fracture of the nasal bones Examination reveals depressed bridge of nose (Fig 1) The patient is blind in the left eye, due to lues He received intensive arsenobenzol treatment

Operation was performed under local anæsthesia (novocaine ½ per cent) Incision made over seventh right costal cartilage close to sternum, tissues retracted, section of cartilage, 2 inches long by ¼ inch broad by ⅓ inch thick, removed and placed in normal saline, field sprayed with dichloramine-T, hæmostasis effected, wound closed with interrupted sutures of silkworm-gut, one piece of rubber dam placed in outer angle of wound for drainage, dry gauze dressing

Novocaine ½ per cent subcutaneous infiltration made in midline of nose from glabella to tip. Vertical incision ½ inch long in mid-nasal furrow tissues retracted, periosteum of frontal bone exposed. With Mayo curved dissecting scissors a subcutaneous tunnel was made from glabella to tip. scissors withdrawn, tunnel packed with dry gauze. Horizontal incision ½ inch in length made in periosteum of frontal bone. Cartilage transplant removed from saline solution, gutter made in deep surface. Transplant with perichondrium uppermost inserted into subcutaneous nose tunnel, after removing gauze packing from latter and mopping latter with dichloramine-T upper flap of periosteum of frontal bone raised with blunt hook, upper end of transplant inserted beneath same. Incision closed with one suture of silkworm-gut. No dressing was applied (Fig. 2)

Case II — Male, white, aged twenty-four, single, pugilist, who was admitted to Polyclinic Hospital (Case Record No 324-9) on December II, 1917 The patient as a pugilist had received numerous blows upon the nose, resulting several times in fracture. In consequence the bridge of the nose is depressed, this forming a variety of saddle nose (Fig 3). The patient states that at one time after receiving an injury he blew his nose and the eyelids filled with air. Physical examination reveals a naturally broad nose, the bridge of which is depressed, so that the anterior nares face somewhat forward. The operation was essentially the same as in the previous case, except that a transversely curved incision was made between eyebrows and with convexity downward. The result is shown in Fig. 4, the patient's friends agreeing that his nose had been considerably improved by the operation.

According to the experiments of Dr John Staige Davis, of Baltimore, cartilage transplants are practically never absorbed, while bone transplants unless accurately contacted with bone and periosteum lead a precarious

<sup>\*</sup> Presented before the Philadelphia Academy of Surgery, May 2, 1918



Fig i —Saddle nose before operation, note short distance between eyelashes and surface of bridge of nose



Fig 2—Nose after operation note great increase in distance between eyelashes and surface of bridge of nose

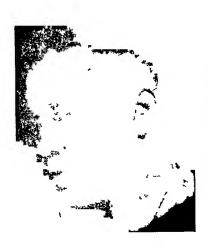


Fig. 3 —Case II Saddle nose before operation



Fig 4 —Case II Nose after operation



Fig 5 — Author s test for determining approximate size and shape of graft to be inserted

#### RIB CARTILAGE TRANSPLANT

existence, and are ultimately more or less absorbed Cartilage has the further advantages of being easily obtained and easily pared with a knife to the desired pattern, while by its elasticity the intervening portion between the ends, which are supported by the frontal bone above and the septal cartilage below, takes up the slack in the skin, thus filling the latter to the required level and without undue tension, the graft itself is not subject to fracture in the event of a blow upon the nose, as would obtain were a bone graft Regarding the use of dichloramine-T, the subcutaneous nose tunnel was first packed with gauze saturated with this substance, thus sterilizing the space and taking up whatever oozing there might be, just as when preparing a pocket in the scrotum for the reception of an undescended testicle One silkworm-gut suture was used to close the wound, which was left exposed to the air. In the first patient there had been some transitory ædema over the forehead after operation, but in the second patient postoperative ædema did not take place. As regards the choice between the supranasal and the intranasal routes for insertion of the graft, the objection to the latter would be the danger of infection spreading to the graft field from the nasal cavity, especially bearing in mind the advice of the late Dr John B Murphy—namely, when preparing the pocket for reception of the graft to take great pains to avoid opening into the nasal cavity with the dissecting gynesic scissors, in order to avoid the ever piesent danger of infection from this source

The frontal bone is nourished and reproduced from the dura, the periosteum covering it being devoid of osteogenetic properties for this reason burial of the upper end of the graft beneath the periosteum of the frontal bone is not done with any expectation of getting nourishment or reproduction of bone from that source, but it is done with the idea of more firmly securing the graft *in situ*. Recent experiments show that cartilage when transplanted establishes nutritional relationship with its host just as surely as bone does

In Figure 5 is shown a test devised by the author for determining the approximate size and shape of the graft to be inserted. With thumb and index finger applied to base of nose at its middle draw the skin forward the skin over the bridge will now resume its normal conformation, and a space will be found between the skin and the bridge, representing the amount of height-loss of the bridge and therefore the thickness of the graft, the anterior nares will drop downward to their normal site

#### ARTERIOMESENTERIC ILEUS OF DUODENOJEJUNAL FLEXURE

#### By WILLIAM H FISHER, M D

OF TOLEDO, OHIO
BURGEON, BY VINCENT B HOSPITAL

In looking over the literature of this subject, one is impressed with the confusion that exists as to its causation, the misnomers that are applied for this condition, and the various inefficient measures advocated for its relief

It is the purpose of this paper to present various facts and salient points that will aid in clarifying this subject and establish it as a true surgical entity with the proper method of treatment

Literature abounds with reports of cases with the title of gastromesenteric ileus, acute dilatation of stomach, acute gastroduodenal dilatation, giant duodenum, acute and chronic duodenal dilatation. All these are the effects of the condition named in the title of this paper and belong to and are a part of the symptom complex, and as such should be discarded, having no claim per se in the nomenclature of surgical entities. For convenience of elucidation, let us divide this subject into three distinct clinical types of obstruction (1) Organic ileus, (2) acute arteriomesenteric ileus, (3) chronic arteriomesenteric ileus.

Before proceeding with the etiology, the anatomical arrangement of this flexure should be considered

This first true flexure of the viscera is at the end of the fourth portion of the duodenum. The ascending portion passes from the right upward, over the fourth and third lumbar to the second lumbar vertebra, then continues as the jejunum, the duodenojejunal flexure being situated at the left side of the body of second lumbar vertebra. The longitudinal musculature of the ascending portion is reinforced by a broad flat band arising close to the abdominal aorta from the crus of the diaphragm and known as the musculi suspensorius duodeni (muscle of Treitz), it serves to maintain the duodenojejunal flexure in position

Albrecht pointed out that this segment of the duodenum has under normal conditions, not a round contour but a distinctly flattened circumference Codman presented casts of a number of duodenums showing definite evidence of compression

Etrology—Braun, Seidel, and Kayser advocate the view "that dilatation is primary in stomach, that duodenal dilatation, if present, is secondary and brought about by kinking at the mesentery. The latter is due to pressure of stomach on the mesenteric vessels and traction of the mesentery of the small intestines. The primary acute dilatation of the stomach is brought about by the action of some toxins on its nervous mechanisms."

Bloodgood reports in two cases "that relief of tension on the mesentery

#### ILEUS OF DUODENOJEJUNAL FLEXURE

and jejunum, pressure on the duodenum and pushing up the dilated stomach did not relieve the obstruction nor allow the duodenal contents to flow into jejunum"

Moore reports two cases of gastromesenteric ileus. At autopsy the pressure of the stomach on the last portion of the duodenum was relieved by turning up the transverse colon over the chest wall. The jejunum remained collapsed and remained so even after moderate pressure had been made simultaneously on the anterior and posterior surfaces of the stomach. After the stretch of the root of the mesentery was relieved, stomach lying in position, the jejunum continued to remain collapsed, but when slight pressure was made upon the anterior surface of the stomach, the jejunum would fill rapidly. The contents of the jejunum were stripped into the duodenum and held there by traction on the root of the mesentery. When the stomach was put in place and the stretch of the mesentery relieved, the jejunum began to fill up, but would cease to fill when slight traction was made upon the mesentery.

More of these cases are reported, but these are illustrative, and an analysis reveals dissimilarity in manipulative results and they are readily explained by a further study into causation

It is not the purpose of this paper to enter into the etiology of the first clinical type or organic ileus of duodenojejunal flexure. The factors that produce it and the pathology are self-evident. But what of the second clinical type, that group of cases where dilatation extends to the flexure, in which there is no evidence of pathological conditions to explain the obstruction other than the normal anatomical factors?

Jordan describes a vivid fluoroscopic picture of a dilated duodenum. The duodenum was half as long again and more than double the width of a normal duodenum. For seven or eight minutes the duodenum was observed undergoing rigorous writhing contractions in a vain endeavor to force its contents through the kink at the duodenojejunal junction. After seven or eight minutes a very powerful contraction of the duodenum forced a large mass of bismuth emulsion through suddenly into the jejunum, and the bismuth forthwith began to arrive rapidly through the coils of the small intestine

This case demonstrates the duodenal musculature had sufficient propulsive force to overcome the partial occlusion

There is a greatly altered physiological relation and increase of the secretions of stomach, liver, and duodenum, due directly to the effects of anæsthesia, especially true in infective cases. The inhibiting influence of narcotics given to relax patient is a contributing factor in the production of gastroduodenal stasis, dilatation with tension ensues and with tension regurgitation. The greater the dilatation the greater the tension, and the greater the tension the less propulsive force of duodenum and the greater the obstruction at flexure. The duodenojejunal flexure ceases to be a normal physiological one and becomes an occlusion, produced by innervation of musculature with duodenal tension.

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Different subjects have varying degrees of angulation of the flexure, this angulation may assume a partial occlusion or be accentuated by certain contributing factors, as compression by mesentery or traction in visceroptosis. The severity of the occlusion then may be gauged by the degree of angulation, or the duodenal tension, or the mesenteric compression, or the visceroptotic traction, acting singly or conjointly

Thus we may readily account for the controversial reports of cases that, lifting the root of the mesentery with the stomach and colon will allow the duodenal contents to pass into the jejunum, while in other cases, even pressure on duodenum with above manipulations fails to empty duodenum

This principle in physics is readily demonstrated by suspending a rubber tube in the fixed anatomic position as the duodenum and filling it with water. There will be distention of tube below the point corresponding to duodeno-jejunal flexure. The more the distention the greater the occlusion. The atomic duodenum, with its diminished propulsive power, is practically an inert tube, and with its increase in dilatation and consequent tension changes a normal physiological flexure into an occlusion.

The duodenum has two other flexures which are not pathologically significant, except congenitally, and are not subject to acute angulation. The result is regurgitation of duodenal contents into stomach. Many of these cases recover under proper medical treatment and recovery is due to the rehabilitation of splanchnics and duodenal musculature.

I am convinced that the foregoing is a true explanation of the causation of intestinal ileus at duodenojejunal flexure in the absence of any appreciable pathological state

Etiology of the Third Clinical Type—In the consideration of the etiology of the third clinical type, Conner in discussing "Dilated Duodenum" aptly says "The mechanical factors involved are still, it seems to me, very obscure There can be no doubt that the obstruction by the root of the mesentery and by the superior mesenteric artery is a real one, but when one attempts to explain what the conditions are that bring about such an obstruction, there are many difficulties—Certain things are obviously necessary, if the mesentery is to pinch the duodenum, it must be tight and there must be traction in a certain direction—Those conditions are fulfilled by the small, intestine being in the true pelvis and being empty, it cannot be in the true pelvis unless it is empty—Apparently the mesentery must be neither too short nor too long in order to constrict the duodenum"

Compression then by the root of the mesentery or traction, either singly or conjointly, are the main causes of occlusion. But the essential contributing factor is the anatomical feature of the flexure. The fixed duodenum, with its varying degrees of angulation, explains succinctly many of the hitherto obscure mechanical factors involved in the production of ileus at duodenojejunal flexure.

Treatment —M Wilms, in discussing high intestinal obstruction, says "The time in which duodenojejunal obstruction causes death has only in the

rarest instances been prolonged. Death usually subvenes with extreme rapidity. All patients succumb to toxic absorption."

Turck has experimentally shown that in such atonic dilatation, "Colloid material can penetrate unchanged into the walls of the intestine and can pass along the submucous tissue cephalad. Reaching the upper intestinal tract they are split up by the action of powerful enzymes in the wall and toxic effects are produced."

When the above condition subvenes in an occluded duodenum toxæmia rapidly obtains with fatal results To forestall this state and properly drain the duodenum is the indication of medical and surgical treatment

Murphy in writing of congenital occlusion of small intestines advocated "When the occlusion is below the papilla a duodenojejunolateralis can readily be performed. The same operation is applicable in occlusion at the duodenojejunal flexure"

Bloodgood, reporting three cases of acute dilatation of stomach, says "Theoretically, also a second anastomosis between the duodenum and jejunum would have to be performed to drain both the duodenum and stomach Future experience may demonstrate in cases of this character a simple duodenojejunostomy is indicated" And further in same article "If the dilatation involves the duodenum I would advocate jejunostomy with passage of tube into duodenum or duodenojejunostomy"

Downes reports a case of giant duodenum in a child of four and a half years "Posterior gastroenterostomy was performed, reoperated one month later and finally recovered" The author believes that duodenojejunostomy best meets the indications and should have been adopted in his own case

Maury, in a series of animal experiments to determine the cause of death in high intestinal obstruction, among other facts deduces this important practical observation "It was further determined that the effect of entero-anastomosis between the jejunum just distal to the gastro-enterostomy and the closed duodenal loop just aboral to the entrance of the bile-ducts gave a favorable result"

In other words, dramage of the obstructed loop is effectual in preventing lethal results

Treatment First Clinical Type—The treatment of the first clinical type is entirely surgical and the operative technic dependent upon the cause Where possible, growths should be excised, strangulated herma in duodeno-jejunal fossa should be relieved, effects of infective peritonitis corrected, enteroliths removed, etc. When not possible to remove cause and relieve the occlusion, the duodenum should be drained, either to prolong life or in expectation of permanent recovery, and duodenojejunostomy is indicated. The following case report of this clinical type is of interest.

History of Case — Joseph R, American, age twenty-one years Occupation, farmer Family history negative Personal history elicited nothing except stomach disturbances from childhood Burning sensation in epigastrium associated with exercise Bananas only food product

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that disagreed with him, producing indigestion with distention Always a tendency to constipation and, when not relieved, vomiting associated with it. Never any gastric pain in early course of disease. A very significant and pathognomonic symptom developed last April. On assuming the upright position, after working in a stooping posture, he was taken with an epigastric pain radiating to back and right of abdomen. Pain was continuous, more or less severe, and compelled him to cease work. Always more severe on regaining upright position.

Condition Found at Operation —Right rectus incision June 19, 1918, revealed a dilated duodenum. The duodenojejunal fossa was entirely obliterated by dilated duodenum and surrounding retractive jejunal peritonitis. The jejunum instead of passing to left and downward was retracted upward and to right, firmly adherent to abdominal vessels and completely flattened against spine. Its course then was downward and to the right

Operative Technic —The surgical consideration was to restore the bowel to its natural position. After careful dissection the bowel was freed from its attachments, the mesentery unrolled, allowing the bowel to pass to the left. The raw surfaces were closed over and a retaining suture was placed on the jejunum to prevent further rotation to the right. The patient was elevated in bed and was kept on left side for three days. Convalescence uninterrupted. Discharged from hospital two weeks later. The keynote of success in the operative technic was the careful dissection to relieve the double angulation and in the proper juxtaposition of peritoneum over vessels, thereby avoiding a future retraction of bowel. Up to the present time he reports himself well.

Treatment of Second Type —The treatment of the second clinical type is either medical or surgical. It has been customary for many years in my surgical service to have lavage of stomach performed immediately following operation on all septic cases, and I am more convinced of its value as a prophylactic measure in preventing gastroduodenal innervation. If after thirty-six to forty-eight hours, despite medical treatment, the tension of the duodenum has not been relieved, epigastric pain, vomiting and gulping, coprostasis, and meteorismus continue with evident dilatation of stomach and duodenum, immediate surgical intervention is indicated. In urgent toxic cases, to drain the duodenum with the least possible disturbance is the surgical technic of choice. Under local anæsthesia a jejunostomy should be performed and rubber tubing passed through flexure into duodenum. Through this tube the duodenum should be constantly irrigated. In less toxic cases a duodeno-jejunostomy should be performed.

Treatment of Third Chinical Type—For the same cogent reasons that have led me to advocate duodenojejunostomy, representing as it does anatomico-physiological, biological, and surgical principles, so also must I discountenance the medical treatment of this clinical type

The medical treatment advocated, is rest in bed over a long period of time, in assuming various postural positions to relieve epigastric distress, and with forced feeding in hope of a deposition of fat in mesentery to prevent its undue compression or traction. As I have

# ILEUS OF DUODENOJEJUNAL FLEXURE

previously stated, this clinical type of cases is produced by three factors that influence the flexure, viz, anatomical features, compression and traction, compression by mesentery and traction of visceroptosis. The effects produced are identical in either factor,  $i\,e$ , atony of duodenum with dilatation and varying degrees of toxemia

From the preceding, duodenojejunostomy is positively indicated Slitting the mesentery is unsurgical, gastro-enterostomy has not one surgical principle to commend it and both should be discountenanced Reports of favorable cases have been made of resection of one-half colon with ileocolostomy for the relief of occlusion at flexure. These cases are of the traction type of visceroptosis. Why such a formidable operation in these cases? Unless directly drained, time is an important element in the restoration of the atonic duodenum. In the interim, contributing factors may intervene and produce lethal effects of this "reservoir of toxicity"

The occlusion of duodenum in lordosis of lumbar spine is due to both compression and traction. A formidable resection is certainly contra-indicated here. A duodenojejunostomy is the operation of choice and if this operative procedure is tenable in such a case, why not more so in less grave cases?

#### CONCLUSIONS

- I Arteriomesenteric ileus at duodenojejunal flexure is a true surgical entity
  - 2 That the anatomical features are predisposing factors to occlusion
- 3 That it has three clinical types (1) Organic arteriomesenteric ileus, (2) acute arteriomesenteric ileus, (3) chronic arteriomesenteric ileus
- 4 That each type has its specific causative factors (a) Occlusion due to new-growths, infective peritonitis, strangulated hernia, cicatricial contraction, enteroliths, etc (b) Splanchnic innervation with duodenal tension and resulting loss of propulsive power (c) Compression by mesentery and its vessels or traction from visceroptosis acting either separately or jointly
- 5 That surgical intervention is indicated and with the above noted exceptions duodenojejunostomy is the operation of choice

# PRIMARY RETROGRADE INTUSSUSCEPTION OF THE SIGMOID ASSOCIATED WITH TUMOR

# By Donald C Balfour, M D

OF ROCHESTER, MINNESOTA

We have recently observed, in the Clinic, a most striking example of a retrograde intussusception occurring in association with a sigmoidal tumor

Power, who made such valuable contributions to the subject of intussusception, states that about 5 per cent are of the retrograde type. However, it is quite obvious from such records as are available of these reverse types of intussusception that the case I present is unique for the reasons that the condition was primary and had not developed as a complication to an intussusception of the usual variety, that it was not a terminal event in peritonitis or obstructive vomiting, and, finally, that the method of its recurrence could be observed at operation

The patient (Case A203308), a male, aged forty-five years, presented himself for examination November 17, 1917 He had been in good health (the appendix had been removed twelve years previously) until October 1, 1917, when a diarrhea began with from eight to ten watery stools a day, but without blood or mucus The general physical examination was negative except for a slight abdominal tympany. The blood, stomach contents and urine, and the Wassermann test were negative, as were also repeated proctoscopic and stool examinations The customary therapeutic measures were suggested, but on March 4, 1918, the patient returned to the clinic reporting that the diarrhoea, still without blood or mucus, had persisted. He had been disturbed by considerable flatulence and borborygmus, and by occasional moderately severe abdominal cramps—the history of an intermittent obstruction The general examination again was negative, but X-ray of the colon showed a filling defect high in the sigmoid, a finding which remained after antispasmodics had been administered 1918, the patient was sent to the hospital, and an exploration (W J Mayo) through a left rectus incision revealed a mass in the pelvic sigmoid There was marked obstruction from the tumor, the sigmoid above the growth showing great distention and muscular hypertrophy On further examination of the tumor (which through the bowel felt like a bunch of angle worms), it was discovered that a retrograde intussusception had occurred (Fig 1), and that the tumor and the section of bowel involved had been intussuscepted upward about three inches Within a minute or two after the reduction of the intussusception (Fig 2), which could readily be done by traction, a strong reverse peristalsis was manifest, and the tumor was again drawn upward by powerful antiperistaltic contractions of the proximal sigmoid, these

<sup>&</sup>lt;sup>1</sup>Dr V C Hunt has kindly assisted me in reviewing the literature of the subject

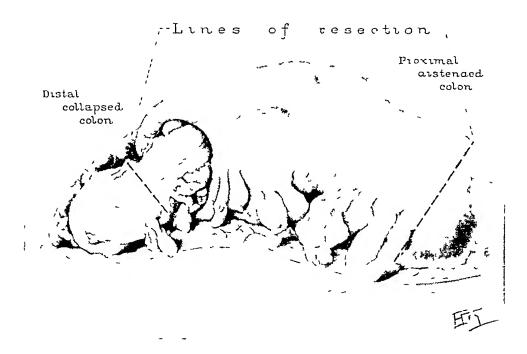


Fig I —Appearance of retrograde intussusception at operation

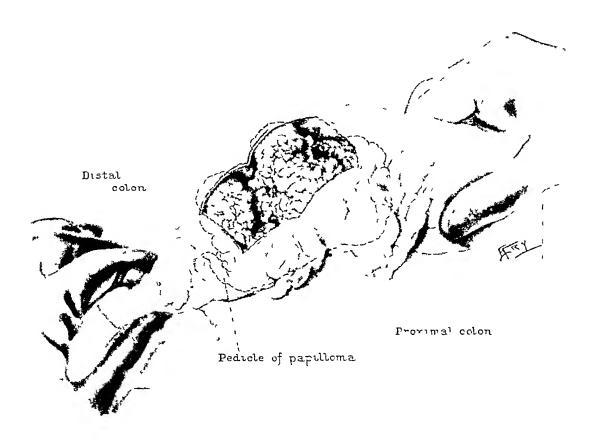


Fig 2 —Intussusception reduced portion of wall of sigmoid removed to show the tumor is site

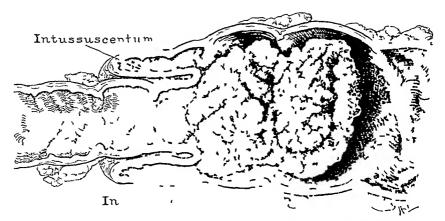


Fig. 3 —Diagrammatic representation of intussusception and tumor cut longitudinally

contractions extending upward for a distance of from twelve to four-teen inches above the site of the tumor. The process of invagination, begun in this manner, continued until the portion of the bowel containing the tumor was drawn upward and completely engulfed by the proximal segment (Fig 3). Ten inches of the sigmoid, including the growth, were resected. An end-to-end colonic anastomosis was done, and the suture line was drawn through the omentum (C. H. Mayo method). There were no enlarged glands, and exploration of the liver and peritoneal cavity was otherwise negative. The tumor itself proved to be a pedunculated malignant papilloma to by 15 cm. (Fig. 2). The abdomen was closed without drainage, but two small rubber tissue drains were inserted down to the peritoneum, and a tube was stitched in the rectum. The convalescence was uneventful

The various theories as to the factors necessary to produce an ordinary intussusception may be applied in explaining retrograde intussusception in The first and most important fact is that, normally, muscular contractions in the large bowel are, at times, antiperistaltic. This is not true of the small intestine, consequently retrograde intussusception in the small bowel is almost always a terminal event, associated either with an ordinary intussusception or with the reverse peristalsis of obstruction. In the large bowel antiperistaltic waves have been demonstrated by Cannon, and he has shown that these waves may be and are produced by a tonus ring, although the conditions which establish the rings are not as yet determined antiperistaltic waves, which are the primary causative factor in retrograde intussusception in the colon, were, in our case, undoubtedly initiated by the tumor, the attachment of the base of the tumor causing a tonus ring just as such rings may be caused experimentally Further, pedunculated tumors are the only variety in which an intussusception may occur, carcinomas, diverticulitis, and inflammatory tumors involve the intestinal wall to an extent sufficient to produce a rigidity which prevents invagination, and these tumors are not pedunculated

The rarity, therefore, with which tumor formation in the sigmoid is associated with intussusception is because of the rarity of the type of tumor essential to such an occurrence. Given the factor of irritation, abnormally strong peristaltic waves are produced both above and below the site of the tumor. In the case under discussion not only did the tumor act as a point of irritation, but the polypoid mass, which was the size of a large orange, lay free in the colon, and as the powerful contractions of the hypertrophied musculature of the colon gripped the tumor they exerted enough pull on the base of the tumor to begin an invagination and a true retrograde intussusception. This invagination was aided, of course, by other factors, the most important of which were the difference in caliber of the bowel above and below the point of partial obstruction occasioned by the growth, the spastic condition in the lower segment, and, finally, a sufficiently long mesentery to give free mobility

# DONALD C BALFOUR

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# A CONTRIBUTION TO THE STUDY OF MYOSITIS OSSIFICANS PROGRESSIVA

# By Julius Rosenstian, MD

OF SAN FRANCISCO BURGEON TO MT ZION HOSPITAL

(From Mt Zion Hospital, San Francisco, Calif)

(CONTINUED FROM PAGE 520)

# Author's Case

L B, newsboy, born 1896 in Rumania, normal confinement Family history negative, both parents alive and well but very ignorant, and the history (previous to his coming under our observation), having been extracted from them under great difficulties, is not as complete as I should wish

Two brothers (nine and twelve) and one sister (fifteen years) in good health. No T B or history of any other systemic disease in immediate family. Immediately after birth the midwife noticed a tumor in the right groin the size of a small egg. This tumor probably contained bony spicula, as the mother, who gave the details of the previous history, describes it as having felt to the touch as though filled with nails. His right leg was also shorter than the left. The attending physician advised a watchful waiting and to postpone surgical interference for one year.

At the end of that time the tumor had grown down the thigh to the leg, while the portion in the gioin had grown to the size of a fist He was operated on at the age of fourteen or fifteen months by a Rumanian surgeon who removed the tumor in the groin, leaving the remainder until the child had grown older and stronger. He stayed several months at the hospital. The parents, somewhat later, emigrated to the United States and at the age of five years patient was placed in the New York Orthopædic Hospital for a second operation

An incision was made from the lower third of the thigh to middle of leg and a part of the tumor apparently successfully removed. The functional result was not improved, the leg remaining stiff, neither flexion nor extension being possible

After three years patient again entered a hospital and remained there another eight months. It is not clear what was done at that time, parents say that a tumor in the upper part of the leg was excised. No further operation was done until he presented himself in my surgical Out-patient Department of the Mount Zion Hospital, under the care of my then first assistant, Dr. A. Newman, now Professor of Proctology C. P. & S., in the latter part of 1908. He complained of pain in the left upper arm and over his right tibia below the knee.

His status at that time was A rather slender boy, good color Head and neck nothing abnormal Left arm shows bony ridge in and under deltoid muscle, extending from below deltoid process and

# JULIUS ROSENSTIRN

along anterior outer surface of humerus to insertion of deltoid tendon Humerus thickened, patient cannot raise his arm on account of pain when attempt is made to bring deltoid into action. Both thumbs show very short and broad last phalanx

In the right groin a scar and another extending over inner part of right thigh, both from former operations. Exostotic growths spring from crest of right thac bone and along the line of Poupart's ligament. There are small isolated isles of bony masses on the abdomen in the right thac region, extending into right obliquis and rectus abdominis half way up to the umbilicus.

The entire adductores region of the right thigh, from their origin down to the lower third of the thigh, stonehard. The anterior part of thigh between lesser and greater trochanter also forms a bony mass, the femur is thickened, as the mass nears the knee it swings backward and entirely fills the popliteal space. Knee completely ankylotic. The mass then passes down along the inner side of the leg into the foot, running along the inner margin of the latter to the big toe. Microdactylia of both fourth toes

Priessnitz compresses were ordered, to be changed every four to six hours. The pain disappeared soon after they had been regularly applied.

Entered hospital on August 31, 1909, with pain in left humerus and lower epiphysis of left ulna, and over right tibia below knee. Attack accompanied by fever. X-ray of left arm and hand shows thickening of upper two-thirds of humerus and periosteal thickening along lower part of ulna. In humerus just above epiphysis, oval wedge-shaped space giving impression of cavity. Tuberculin test negative. Under treatment with warm Burow compresses pain gradually disappeared but left thickening along ulna. Discharged October 2, 1909.

He was not seen again until the latter part of September, 1910, when he came into the clinic complaining of severe pains in the left It was, swollen, and painful to pressure and percussion all along the upper two-thirds of the humerus, and the skin appeared slightly ædematous The pain had begun about a month before, but his great fear of a possible operation had kept him away from us until the pain had grown too violent to bear Rest, ice and diluted Burow solution compresses were first tried, upon the urgent request of the boy, but gave no relief, and on October 2, I made an incision over the anterior and outer aspect of the humerus through the fibres of the deltoid, from the shoulder downward along the upper two thirds of In the region of the insertion of the deltoid tendon the bone was bared, and on finding considerable roughness, an opening was made into the medullary cavity A small quantity of pus was found in the medullary cavity (two cultures taken), together with considerable granulation tissue. The upper two-thirds of the cavity of the shaft were opened and curetted clean, until normal tissue below and above was found The cavity was dried with the Hollander hot-air instrument and an equal part mixture of carbolic acid and tincture of iodine applied over entire exposed surface, after all bleeding

had been stopped. A paste of plaster of Paris, composed of sterilized plaster in 1 to 500 cyanide of mercury solution to fill the entire cavity is put in and allowed to harden. Periosteum and muscle are united with interrupted catgut, and skin with continuous silk sutures. Uneventful recovery. (Culture staphylococcus, no T. B.)

In the latter part of April, 1911, the patient came to us again complaining of considerable pain in the right iliac region during locomotion but not while at rest Examination shows lower 5 cm of right rectus muscle ossified Mass very haid, a sharp-edged piece of bone raising skin tight

May 13th Incision 5 cm long parallel to Poupart's ligament and about 1½ cm. internal from it near insertion of right rectus muscle Muscle here completely ossified and a spur 2½ cm long and 1½ cm thick protruded down into the tendinous part, but entirely free from os pubis It was removed, edges of muscle smoothed and wound closed Discharged May 23, 1911

A small piece from the lower edge put in trichloracetic 'acid for decalcification and microscopical examination

On August 15th, 1911, returned to hospital A large spur had formed, extending from the right anterior iliac spine to the edge of the obliquus externus of that side about 5 cm long and 3 cm wide, causing considerable pain Incision over spur; blunt separation of adherent muscle and chiselling off of spur from anterior iliac spine. The rough bone edges smoothed off and hæmostasis with hot saline solution Fascia united with chromic catgut, skin subcuticular. Uneventful healing, discharged August 30, 1911

Returned in September, 1912, complaining about two closely neighboring ventral herniæ in the right iliac region where previously osseous plates had formed and which had been extirpated. The muscular fibres had atrophied and the ventral hernia developed. An attempt was made to bisect longitudinally a piece of the sound upper part of the right rectus abdominis muscle into an anterior and posterior half, and having tied off and resected the peritoneal sacs, turn the anterior flap down over the hernial apertures and fasten it to the lower tendinous part. The result was not very successful, part of the muscle-flap sloughed and the defect in the abdominal wall was only slightly improved.

About three weeks after operation the patient's face and both arms became cedematous and a marked hæmaturia appeared. The face and arms resumed their natural condition after two days, but the hæmaturia remained for several weeks. It finally cleared up without leaving any trace, nor has it ever returned since (Late ether nephritis?)

A cystoscopic examination was stubbornly refused by the patient Urine contained at first some granulated casts together with blood After a few days casts disappeared. No pain or dysuria

We did not see him again until May 26, 1914 As the status since then has remained about the same, I will give the one taken at that date

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Status - Good complexion, red cheeks, looks like a boy of 15 years Is underfed, weighs 113 pounds, rather infantile habitus, voice harsh

and deep

Head well-shaped and covered with an abundance of black hair Face smooth, no sign of beard Eyes clear, pupils equal, dilated, react to light and accommodation Mouth Mucosa normal, tongue clear, teeth carious, gums show signs of pyorrhæa alveolaris

Pharynx inflamed, tonsils normal Neck long, slender, no general glandular enlargement, thyroid gland not palpable, no visible pul-

sating blood-vessels

Sternum in depressed groove, insertion of ribs on both Chest sides forming convex arches to body and ensiform cartilage (ratite or ecarinate chest), entirely free from hair, which is also absent in the axillæ Excursion on normal respiration is not marked Breathing is mostly abdominal On deep breathing, however, thoracic move-Expansion is about 5 cm Mobility on both ments are extensive sides equal

No muscular resistance, T F somewhat exaggerated Palpation on right side Percussion and auscultation normal, slight bronchovesicular breathing below second and third interspaces Slight lateral curvature

The left arm shows a scar from the acromial process to the middle of the humerus, on its anterior and outer surface is thickened and rough and of irregular shape up to its middle, where it again assumes its normal size and contour. The change in form of the upper part consists of a nodulated groove 3 mm deep on its anterior and outer surface. In the right iliac fossa, beginning about 3 cm below level of anterior superior iliac spine, free osseous plates can be felt in the rectus and external oblique muscles skin is freely movable over them, but they are firmly imbedded in the Hardly any hair in pubic region

From the right horizontal branch of the pubic bone an 'exostosis starts upward in the substance of the obliquis muscle for about 5 cm

Its base is firmly attached to the os pubis, it is about one-half a ctm wide and grows gradually wider toward the tip, where it is 21/2 ctm. Near the tip a free osseous plate, at the edge of the right rectus, is movable and moves with respiration. This plate is about the size of a large melon seed There are two smaller exostoses, one on each side of the large one, firmly connected with the pubic bone, the outer one, extending down to the large ossification of the thigh, connected with the femur, the inner one, near the symphysis, nearly joining the loose plate in the rectus above it This exostosis is about 3 cm by 11/2 cm

Between the outer and middle, also between the middle and inner exostosis, the muscle and skin are atrophied in two places and a ventral hernia protrudes through each of them, giving a marked vis-

ible and palpable impetus upon coughing

The right thigh is ankylotic in hip joint and is flexed at an angle of about 35° and adducted The knee is also ankylosed and in flexion at angle of about 25°

The right leg shows ossification of the entire adductor and hamstring muscular groups, extensors and abductors not so well developed as on opposite side

Circumference of middle of thigh—right, 30 cm, left, 47 5 cm Circumference just above patella—right, 28 cm, left, 32 5 cm

Nearly the entire mass of the inner and posterior muscles of the right leg is ossified, except the extensors, the peronei, the tibialis anticus, and the lower part of the soleus

C11 cumference of calf—right, 24 5 cm, left, 31 5 cm Length of leg—11ght, 67 cm, left, 80 cm

Flexion of right foot is very limited, but movements of tendon Achilles are felt very distinctly. The foot is in adduction and its inner two-thirds ossified up to middle of metatarsal bones. The fourth toe of each foot is small and bent across third toe.

Patient complains of pain in the right lumbar and inguinal regions, particularly severe when standing erect. This pain commenced in a slight degree about eight months ago and gradually increased in intensity and duration, becoming lately so severe that patient was compelled to give up his work and apply to the hospital

Examination Shows small spur of bone in the right inguinal region about the middle of Poupart's ligament, about 1½ centimetres long and pointing towards horizontal branch of the pubic bone Another sharp spur is on inner side of the femur, to the inside of crural canal

Operation (May 28, 1914) —Incision over both spuis, the one in the abdomen can be easily removed by excision. Attenuated muscle and fascia are sewn together with catgut and skin with Michel clamps. The spur on the inside of the femur lies directly under the skin, and after incision it is removed with chisel, after hemorrhage has been stopped the skin is united with Michel clamps. Both wounds healed by first intention. Patient dismissed June 8th

Returned to hospital October 25, 1915 Patient has been perfectly well ever since leaving hospital About ten days ago he began to have pain over posterior surface of arm just above the wrist. This is a sharp sticking pain which comes on on movement of wrist or contraction of muscle of forearm. Greatest pain is when he flexes the wrist. Appetite good, bowels regular

Examination reveals small highly sensitive exostosis, about the size of a small melon seed, over lower end of radius on doisal surface, small hard nodule in *skin* above extensor tendon two inches above the wrist Nodule is freely movable with skin and sensitive. Similar nodule over middle of left calf, underlying muscles and entire posterior part of left leg free from any other ossifications.

Heart and lungs normal

A coagulation test of patient's blood was made, found normal, time 5 minutes

Operation October 27 —For removal of exostosis on posterior surface of radius two inches above wrist joint Esmarch's bandage applied to hand and arm, up beyond elbow Local anæsthesia with novo-

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came A longitudinal incision was made through skin, and subcutaneous fascia tendons of extensor muscles separated, deep fascia and periosteum incised and the latter levered from bone with elevator and pulled aside. The bared exostosis was then removed with bone forceps and base smoothed off with chisel. The small nodule with a small oval of surrounding skin was then removed under local anesthesia for microscopical examination, also that on left calf Wound over wrist closed in two layers, deeper layer with interrupted catgut sutures, all skin wounds closed with Michel clamps. Dismissed October 31, 1915, after uneventful recovery

Returned to hospital February 7, 1916 Complained of severe pain in right knee Pain worse at night

P I—About two weeks ago patient had a swelling on the medial side of the right' great toe, which was very sore. At the same time the right knee on the lateral side became sore and a little swollen. The sore on toe did not break open but dried up and left a brownish scar. The knee continued to pain and kept the patient awake at night

Examination shows swelling at outer part of right knee, occupying entire lateral surface and extending about I centimetre to the under surface into the popliteal region. Patient was confined to bed and a wet dressing applied to the knee.

February 13th Pain in knee is less Temperature varies from 37 2 to 38 4 Blood count Leucocytes, 18,000, polys, 82 per cent Patient refuses incision

February 15 Cast applied to knee

February 17 Pain worse Cast removed and compress of Burow's solution applied

February 18 Pain worse, temperature 379 to 384 W B C, 25,000, polys, 83 per cent

February 19 Ice bag applied to knee

February 20 Temperature rose to 399 Hot-water bag instead of ice bag Pain somewhat relieved

February 21 Patient taken to surgery Two red inflamed areas were seen on the lateral aspect of the right knee. These were fluctuating and soft. Under local anesthesia the fluctuating areas were opened by incisions and a rubber tube inserted. A considerable quantity of yellow pus escaped.

February 22 Complains of pain on the inside of the knee Highest temperature, 387 Similar nodules and swelling on inside of knee and indistinct fluctuation

February 23 Abscess on inside of knee opened and drainage tube inserted Highest temperature, 379

February 24 Feeling much better, slept well, highest temperature, 37 3

March 10, 1916 Two very small spiculæ of bone directly in skin, one on the right arm near insertion of deltoid muscle in outer groove, the other in popliteal fossa of right leg. These were extirpated, together with the skin containing them, for microscopical examination Wounds sutured with silkworm gut

Maich 15 Sutures removed from aim incision, union per primam March 16 Patient removed bandage from arm during night, wound broke open but quite clean Edges approximated with adhesive

March 17 Sutures removed from leg incision

March 20 Hand and arm healing rapidly Wound in leg clean and healing

Discharged to come to clinic for treatment

Small spurs of bone in the abdominal wall projecting with their sharp edges into the skin and giving considerable pain were removed on January 15, April 6, July 30 and December 30, 1917 The muscles and fasciæ in the places ossified by these pieces of bone have entirely disappeared and the lower surface of the bone is adherent to the peritoneum

X-RAY FINDINGS March, 1918—Hands Both thumbs and second and third fingers show a diminutive last phalanx

Abdomen, Pelvis and Right Thigh The right side of the abdominal wall from the level of the crista ilii downward shows ossification in the muscular strata partly free, partly connecting with the pelvic bones. There is a scoliosis to the right in the lumbar vertebræ (compensatory) The pelvis is tilted from right The right crista ossis ilii stands about 3 cm higher than the left part of the os ilii forming the upper and posterior border of the acetabulum is much broadened and the entire frontal part of the right pelvis is obscured as through a thick veil by the ossification of the overlying soft parts so that the right foramen obturatorium seems obliterated in the picture. The neck of the femur stands in an angle of 160° to the shaft and the head is synostotically fixed in the acetabulum. The large trochanter is imperfectly developed, the smaller one relatively better The shaft of the bone is less than one-half the thickness of the left femur The entire anterior space ordinarily occupied by the adductor muscles is here changed to a solid mass of bone, which goes down to slightly above the internal condyle, where it merges with the contours of the femur and tibia in the formation of the completely synostosed knee-joint. The atrophic patella and its ossified ligament occupy their normal positions from the femoral attachment to the insertion at the tuberosity below the much-enlarged head of the tibia

Right Leg The outlines of the enlarged tibia can be traced in the picture. The soft parts in the popliteal fossa and all along the posterior part of the leg are nearly entirely ossified. The anterior part and the interosseous space are fairly free. The fibula is comparatively slender.

Right Foot The foot shows an almost complete synostotic conglomerated mass of the ankle bones and calcaneus, together with the ossified muscles and tendons of the dorsum and part of the planta. There is a faint outline of the cuneiform bones at the base of the metatarsals and in the lateral view a similar one between the astragalus, the scaphoid and the first cuneiform. The metatarsal have retained their separate condition with their part of the interosseous muscles between them. The first metatarsal bone is very much enlarged in circumference through the ossification of its surrounding tissue, the fourth toe is microdactylic through a small metatarsal

The left hip-joint shows a condition resembling coxa vara

The left foot shows a partial synostosis of the metatarsal and cuboid bones and the same condition as of the fourth metatarsal as the right

Microscopic Histology—Decalcification in trichloracetic acid, stain hæmatoxylin, cosin and Van Gieson The topographic relations of the various formations of the

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ossifying process to the epidermis are illustrated in Fig 9, and present the extreme distance of the bone formation from the epidermis in any of my sections. To save space and expense, this relation is shown only where essential in the subsequent pictures

Embedded in the distended and torn meshes of the corium are variously sized nests filled with red blood-corpuscles. Throughout these hemorrhagic masses a few more or less slender tendrils of the torn connecting tissues are remaining. The smaller of these masses show no appreciable changes discernible in the surrounding tissue. In the largest one sees greater tissue destruction within the hemorrhagic deposit and a slightly denser (pressure) approximation of a few connective-tissue fibres along the border encircling the hemorrhage.

There are few connective-tissue fibres within the blood extravasation, they are not so close together, the interstices between them larger, and around the margin of the hemorrhagic depots a circlet of the distended connective-tissue fibres. These fibres are the first indication of the local boundaries in the later ossification

In these and in many of the later-stage sections a zone of badly stained or totally unstained tissue is observed surrounding the forming ossifications. I claim these to be areas of more or less impaired tissue nutrition caused from pressure of the initial hemorrhage.

In more advanced fields with large hemorrhagic central areas one observes a marked hyperplasia of the immediately surrounding connective tissue. There is a distinct oval shape of the border, forming a growing ring of densely crowded fibres and issuing a communicating network of branch lines throughout the hemorrhagic masses, dividing them into alveolar-shaped compartments. Sometimes these branches do not form and we encounter then in the later stages fully enclosed ossified rings enclosing homogeneous hemorrhagic centers. The progress of osteogenesis is from within outward, the region adjoining the erythrocytes representing the youngest stage. The erythrocytes apparently change into or stimulate the growth of fibroblasts. These cells are forming bone (layers) by apposition, the youngest toward the centre, the older outer ones gradually changing into osseous structure.

In a still more advanced stage, at a period preceding and during the beginning and progression of calcification, the outer encircling ring loses gradually its fibrous structure and becomes a lamellated homogeneous structure, with regular bone corpuscles and canals, or reaches this final osseous stage through an intermediate change from the fibrous to the cartilaginous tissue, in many instances during this metamorphosis the osseous border encloses firmly, and in many parts meets, without any intervening tissue or interior branches, the imprisoned mass of red blood-corpuscles

This direct chain of transformation, however, is not the only one. In some parts we meet a single row of osteoblasts located nearly exclusively along the inner borders of the bone ring or situated in shallow lacunæ and contributing their share to the bone-formation in the outer ring and along the inner branches. They are very large mononuclear cells, the origin of which remained uncertain, perhaps conjoined transformed fibroblasts, as their gradual structural changes can apparently be followed in successive stages. The cartilaginous route finds its representatives at other places where a condensed connective-tissue mass around a primary hemorrhage changes, with the aid of the enclosed extravasation, from its fibrous condition to a homogeneous undifferentiated hyaline basal structure, with large cartilage cells of principally monocellular type imbedded therein. There the younger inner portion of the ring still shows cartilaginous tissue, while at the same location the adjoining outer part is changing into osseous structure.

This ossifying ring has in many instances an inside lining of single or multiple rows of fibroblasts. These fibroblasts crowd together and lose their identity in joining to build up the homogeneous mass. One sees in places an apparently gradual change of erythrocytes into fibroblasts, the precursors of the bone-tissue, small,

spindle-shaped nucleated cells, the youngest not larger than the red blood-corpuscles. They are lying at the inside of the ring between it and the central mass of unchanged erythrocytes, some, as possible witnesses of their new osteogenetic functions, still recognizable near the growing outer ring of bone tissue. At places there are finger-or fungus-shaped protuberances forming various sized and shaped projections from the outer ring into the hemorrhagic mass. At its inner irregular, ragged edge, blood-corpuscles and fibroblasts are fairly mixed in their genetic endeavor to serve as the building material for the new bone. Osteoblasts also take their part in the neoformation, but, as mentioned before, are nearly exclusively distributed at the inner side of the surrounding bone ring.

Other fibroblasts by crowding closely together form the ground substance in places within the central hemorrhagic mass for the new-bone islets and branches Some of these are still interspersed with cartilage-like cells, which later, during the process of calcification, give way to the bone corpuscles and their ramifications

New islets appear in many spots of the central mass They grow and became confluent, and an intertwining network of new bone structure is formed extending from the inner side of the surrounding ring throughout the inner space blasts leading the way for all this new structure extend cobweb-like bands developing into progressive stages of ossifying tissue, new-formed capillaries fill every interstice, and, as a resultant from united efforts, they gradually present the picture In another stage the calcified connective-tissue ring of bone and bone-marrow around the blood extravasation has consolidated from the inside of the ring outward. the cells have lost their individuality, have formed one solid striated mass with the interspersed bone-cells, calcification and ossification have changed the fibroblasts into an elliptic more or less closed ring of bone tissue surrounding the remaining erythrocytes. which show various stages of apparent transformation They are more or less closely connected with the inner surface of the bony ring, separated in some places from it by a very slender single layer of spindle-shaped cells, in others, touching it directly

In these latter places the bone is still in the making, and so closely are the erythrocytes interwoven with the youngest spindle-shaped fibroblasts entering into the new bone-formation, that, contrary to all genetic doctrines, one could imagine the direct transformation of blood-cells into these bone-forming cells, which, in changing from the round- to the spindle-shaped form, become nucleated, growing gradually and less separable form in intermediate stages the ground substance, and, with the appearance of the bone corpuscles, the connecting link between the blood-cells and the finished bone tissue. At other places the above-described cartilaginous route is seen where the inside younger parts of the ring show cartilage tissue, while the adjoining outer ones have already changed to bone substance

The fate of the central blood extravasation is a varied one Simultaneously with the apparent participation of the blood-cells in the construction of the bone ring there is an energetic growth of interlacing branches extending from the inner side of the ring, forming a network of slender bands throughout the enclosed space branches are at first composed of one layer of spindle-shaped fibroblasts, suggesting their origin from transformed erythrocytes, and inclose in the meshes of the net a proportionate quantity of blood-cells from the original extravasate. Layer after layer is added to the first thickness of the branches, the structure of which with increasing volume, like the outer ring, becomes denser and undergoes the change into bone, forming a progressively continuous network of its own, which still encloses the remnants of the more or less changed erythrocytes In other places of the sections, occasionally near initial hemorrhages (Fig 40), some minute specimens of bone are seen, which are solid throughout and the ossification of which has apparently proceeded in adding fibro-osteogenetic layers, filling in the space within the outer border line with a finally solid tissue, thus eliminating the trabecular crosswork, but showing even at these stages in some places the enclosed remnants of the pioneer blood-extravasate, fibroblasts, or less changed erythrocytes

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This apposition from within, however, is not the only means of osseous growth. In a few places there also is a small aggregation of fibroblasts at the outside of the ossifying ring adding to its growth, but no osteoblasts appeared anywhere on the outside, showing that their location seems strictly limited to the inner aggregation of erythrocytes. In some sections a hypertrophic growth of outer connective tissue, participating in the ossifying process, may be seen to enter through a gap in the branches of the partly open osseous ring and closing it first with a connective-tissue bridge, which later ossifies, having previously sent a continuation of the ingrowing tissue from the gap toward the inner side of the ring. In others there is a predominant erythrocyte participation in the bone-formation of the ring.

We may even in some isolated instances get pictures that suggest a prevailing bone-formation from the outer side of the ring, the connective tissue changing directly to bone-tissue by calcification and development of bone-corpuscles and canals

In these cases the inner erythrocytes play a minor part in the final ossification, the major part is taken by the connective tissue direct

The structural changes of the hemorrhagic nucleus do not always keep pace with the development of the bony ring in all parts of an ossified nodule nor in every specimen of a series, and allowances have to be made for more or less of the erythrocyte-filling dropping out during the course of preparation, especially from paraffin sections. Thus we see pictures where a completely unbroken osseous wall closely surrounds a structurally, nearly unchanged, inner hemorrhagic mass. In others a more active participation of the connective-tissue growth in osteogenetic activity and a rather regressive metamorphosis of the enclosed hemorrhagic centre part.

In all these various formations the primary incentive is the hemorrhage with a consecutive connective-tissue growth, and whether the final result is a spongeoid or a solid bone, the route to it directly from the erythrocytes into ossifying fibroblasts or from those via fibrous connective tissue, hyaline or fibrous cartilage, with or without the help of osteoblasts, we have always to look back to the first hemorrhage as the starting point

# ANALYTICAL STUDY OF REPORTED CASES

Before we proceed to analyze these 120 cases, we must explain that five of the number (four male and one female) were only entered in the list on account of their having figured in all the former compilations, and might be classified as "overlooked" by later investigators. They are the cases of E. Schwarz (No. 35), Kronecker (No. 36), E. Lexer (No. 50), Eichhorst (No. 53), and Krause and Trappe (No. 86). Neither of these is myositis ossificans progressiva, and they must be deducted from the total combined number (120-5-115). Four of these are males, one a female, so we have among 115 true cases 68 males, 42 females and 5 where the sex has not been recorded—a somewhat different proportion from former statistics. (Rolleston, 5 to 1, Nissim and Weill, 38 to 12)

Their ages at the time when the first symptoms were observed were in the period before Muenchmeyer's classification (1868)

Males—0-5, 2, 5-10, 0, 10-15, 3, 17, 1, 18, 2, 21, 1 Females—8, 2, 5, 1, not recorded, 8 Not myos prog, 5

After Muenchmeyer's Males—0-2, 19, 2-5, 23, 5-10, 7, 13, 2, 14, 1, 18, 1, 19, 1, ?, 1 Females—0-2, 10, 2-5, 17, 5-10, 10, 12, 1, 20, 1 Sex and history unknown, 1



Fig. 1 —a, area of ossification in abdominal wall, b central hernia

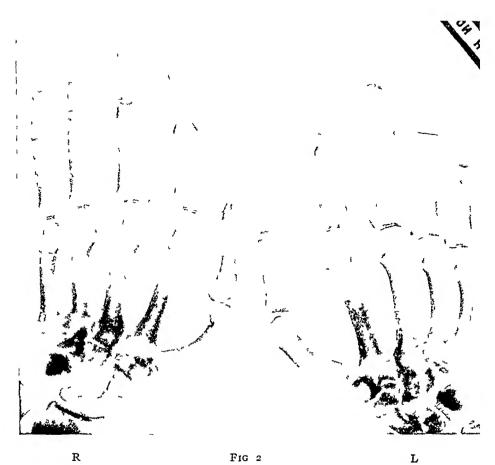


FIG 2

L



Fig 3

n. knee

FIG 4



Fic 5



Fig 6

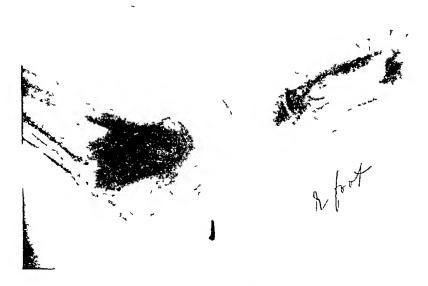


FIG 7



Lic 8

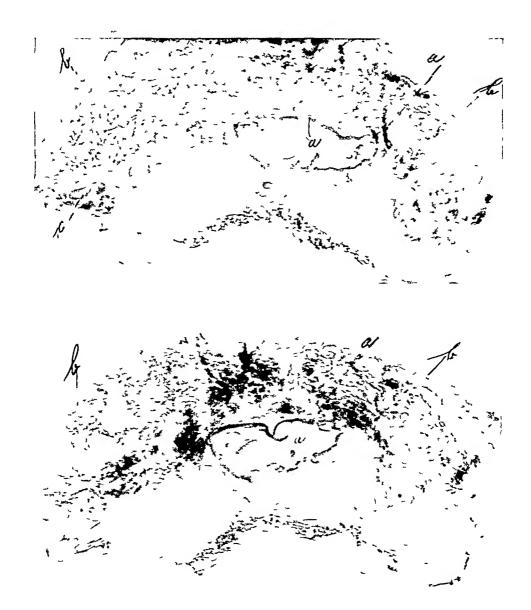


Fig. o.—Topographic view of skin sections with bone ring. a bone ring, b epidermis

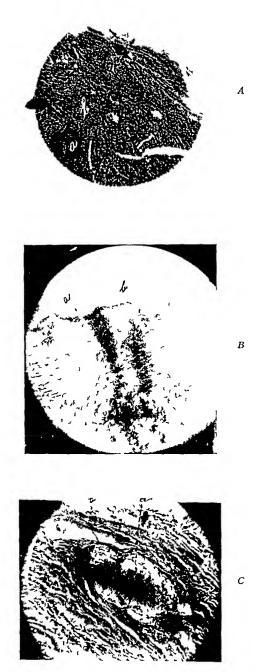


Fig 10 — The initial hemorrhage A low power (oc II obj 16) a hemorrhage (earliest stage), b invasion of surrounding area B low power (oc II obj a\*) a hemorrhage b epidermis C higher power (oc II obj a ap) a hemorrhage, b connective tissue

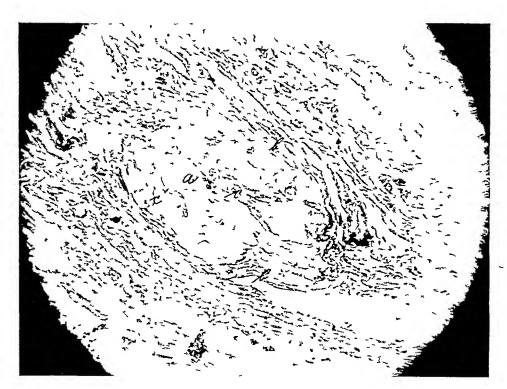


Fig. 11 —a primary hemorrhage b beginning of boundary formation c displaced and torn shreds of connective tissue strands. Enlargement of Fig. 10 C

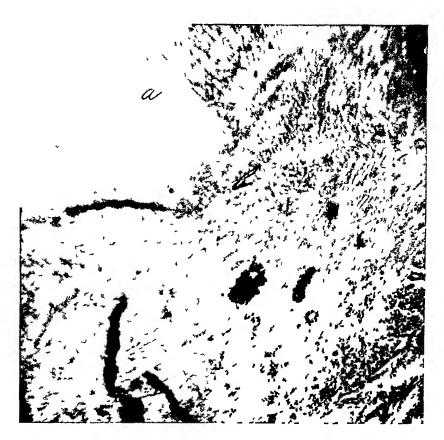


Fig. 12 —a, primary hemorrhage, b, invasion into surrounding normal tissue—Enlargement of Fig. 10 1

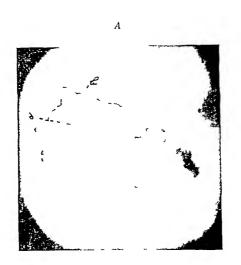




Fig. 13.—Initial hemorrhage with beginning encapsulation. 4 low power (oc II obj a \*) a hemorrhage b epidermis. B higher power (oc II obj 8) a hemorrhage b beginning connective tissue circlet



B

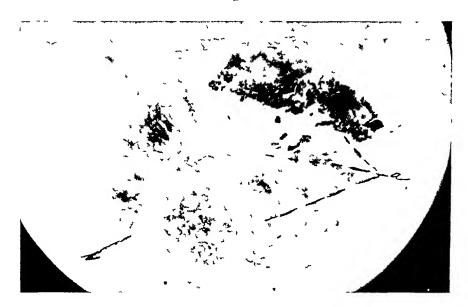


Fig. 14 —Initial hemorrhage with advanced connective tissue encapsulation 1 (oc II obj 6) a hemorrhage, b connective tissue circlet B (oc 5 obj 8) a hemorrhage, b connective tissue circlet



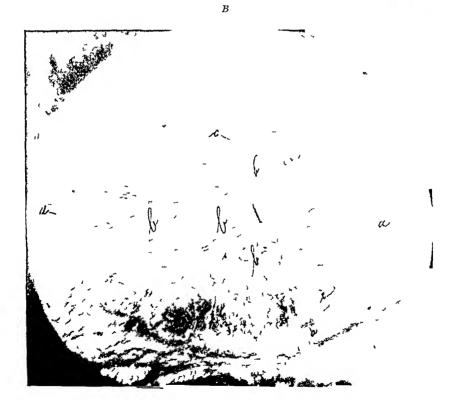


Fig 15—A a beginning of ring formation b erythrocytes c change of form of erythrocytes to spindle shape B Ring formation nearly completed a, newly formed ring b erythrocytes, c slight projections from ring into erythrocyte mass



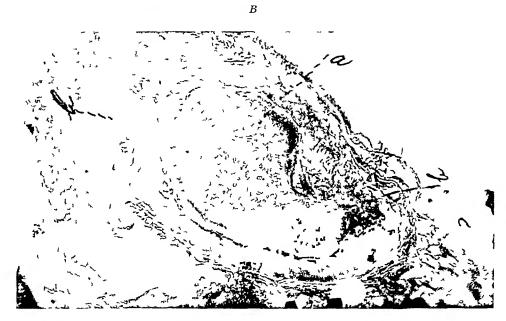


Fig. 16 —Solidification of outer connective tissue ring hemorrhagic centre 1 a hemorrhage, b solidified osseous ring (oc II, obj. 16) B a, hemorrhage, b, solidified osseous ring (oc II obj. 8)

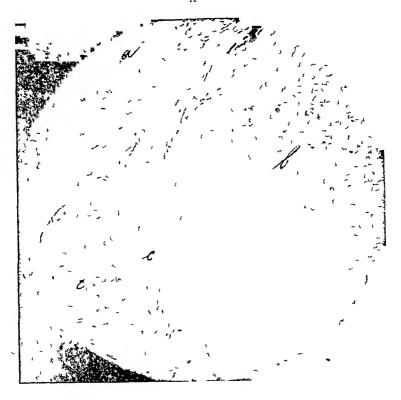




Fig. 17—4 Solid hemorrhagic mass in close apposition to ring in advanced stage of ossification (enlarged part of Fig. 17)—a bone ring b mass of crythrocytes c change of form of crythrocytes to spindle shape Enlargement from part of Fig. 16—B Solid hemorrhagic mass in close apposition to ring in advanced stage of ossification (enlarged part of similar section as Fig. 16)—a bone ring b mass of crythrocytes to spindle shape

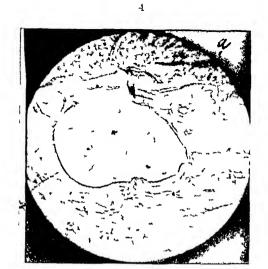
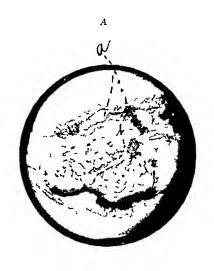




Fig. 18—Cartilaginous tissue bordered on inside of ring by fibrous on outside by osseous tissue A a place where magnified picture was taken (oc 2 obj 16) B a fibrous part, b cartilaginous part b', fibroblasts changing into cartilage cells, c osseous part (oc 6 obj 8) Enlargement of A, (a)



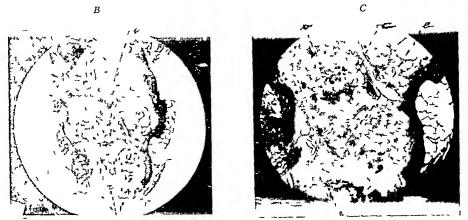


Fig. 19 -4 Osteoblasts on both sides of ossifying branches a outer ring b osteoblasts (oc - obj -) Osteoblasts on inside of ossifying ring and erythrocytes participation B a osteoblasts inside ring b erythrocytes participation and apparent change (oc II obj 8) C a osteoblasts inside ring b erythrocyte participation and apparent change c osteoblasts at branches

A glance at these two groups shows the first observations of the initial symptoms at a remarkably earlier average in the second group than in the first. Although the number of the first is too small for a valid comparison, still the influence of Muenchmeyer's publication in drawing the attention of the profession to this mysterious disease cannot be ignored

Since Helferich's enlistment of the congenital digital deformities among the symptoms of this affection their registration has not been followed by We believe that they are present in practically all genuine cases, and consequently of the ninety-three cases of this series the thirty-one where they have not been registered demand an explanation In the first place, we have to deduct the five spurious cases already mentioned, and one of the other remaining (Bernacchi, No 42) shows plainly on the accompanying photograph microdactylia of the thumbs All of the other twenty-five who answered my inquiries (six) as to the presence or absence of these congenital deformities in their cases admitted that they had failed to look for them In fact, all the thirty-one histories, with one exception, contain no reference to this symptom, and in my abstract of their cases I always inserted under the heading of congenital deformities, "not mentioned" There is only one author (Salvetti, No 79) who specially dwelt on the absence of microdactylia' of either fingers or toes in the description of his case, but his subject was very young (four years) at the time of observation, when slight differences in the size of fingers or toes may easily escape notice, and a decisive X-ray showing the condition of the epiphyses was not taken Several of the remaining cases have as their only records brief demonstrations before My conviction, therefore, that every genuine case of medical societies myositis ossificans progressiva shows mycrodactylia of either fingers or toes, or both, holds good in spite of the nineteen questionable cases loudly in my belief in the failure of noticing this symptom stands the example of the great master of close observation, Rudolf Virchow, who failed to mention it in the history and description of his celebrated case (No 46), while attention to the presence of microdactylia was called later by Gerhard in the discussion following the demonstration in the Berlin Medical Society The malformations present in the cases were distributed as follows

Cases after Helferich (1879) Thumbs and big toes and little fingers, 6, all fingers and big toes, 2, thumbs and fourth fingers, I, thumbs and big toes, 24, big toes, 29, fourth and fifth toes, I

The very marked preponderance in this compilation of the big toes, they being alone or in combination with other terminal parts of the extremities the seat of the brachydactylic deformity, is shown by their being represented sixty-one times in the sixty-three available cases

One does not wonder that a disease, so baffling in its course, from the first causes to its ultimate state, should invite the speculative as well as the patiently investigating observer to lift the obscuring veil and solve this embarrassing puzzle

One of the first attempts to explain the mysterious process was the

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theory of a retention of calcium in the organism due to a faulty metabolism which failed to excrete its quota of lime. This excess of lime in the fluids and the tissues was presumed, by its mechanical or chemical action, to exert an irritating influence and cause ossification.

H Duvy, in Abernethy's case, was the first to examine the urine of these patients for phosphate of lime and found the quantity lower than the average This was confirmed by Dittineyer<sup>1</sup>, Helferich<sup>2</sup>, Pinter<sup>3</sup> and Partsch<sup>4</sup> Duvy, Partsch and Pinter found in addition the excretion of urea normal, of uric acid, kreatinine and earth phosphates, diminished

As all these investigations were confined to the urine alone, without regard to fæces or to exact account of the intake, they are valueless and must be rejected

Very exact and complete analyses, however, have been made by Burgerhout's and Austin's, both giving absolutely negative results. As Burgerhout's excellent work, besides being buried in a dissertation, is written in Hollandish, and Austin's has been published separately from Painter and Clarke's case, which served for the investigation, I shall give both their tables here in full. They are self-explanatory and Burgerhout's deductions are conclusive

Burgerhout's comments on these tables are as follows "According to the results of the examinations of our patients, no difference in the exchange of matter'seems to be observable. The metabolism according to the figures certainly does not deviate from that of normal persons. Under ordinary circumstances the resorption of the necessary amounts of nourishment leaves nothing to desire. The greater increase in this patient's bone-tissue produces no typical alteration in his metabolism through the composition of food which at all times exercises a governing influence upon the phosphates

The daily diet during A and C was 151 milk, 250 gr bread, 100 gr rice, 75 gr butter, 50 gr sugar, and one cup of Liebig's bouillon, calculated as follows

	Albumen	Fat	Carb Hydrates
ı 51 milk	46 875 gr	45 gr 2 5 gr	67 5 gr 150 gr
250 gr bread 100 gr 11ce 75 gr butter	21 875 gr 6 875 gr o 468 gr	o 9 gr 65 25 gr	77 5 gr
50 gr sugar	0 400 8	-3 -3 g-	50 gr
	76 2 gr	113 5 gr	345 gr

Equal to 2782 calones, or about 32 calones per kgr bodyweight (Patient lying nearly motionless in bed )

<sup>&</sup>lt;sup>1</sup>Op citat

<sup>&</sup>lt;sup>2</sup>Op citat

<sup>&</sup>lt;sup>3</sup>Op citat.

<sup>&</sup>lt;sup>4</sup>Op citat

Op citat

<sup>6</sup> Journal of Medical Research, 1907, vol 2vi, p 452

TABLE A FIRST PERIOD URINE ANALYSIS

Date	Quan- tity	Sep W	CI	P2O8	N	CaO	MgO	Kr	Body Weight
June 29 June 30 July 1 July 2 July 3 July 4	1280 800 560 1430 1180 1020	1016 1032 1029 1020 1023 1023	4 268 4 557 3 971 6 759 5 792 5 192	1 805 2 292 1 053 1 837 2 136 2 025	8 996 12 611 6 372 9 810 9 416 6 569	0 228 0 197 0 207 0 262 0 244 0 235	0 076 0 074 0 057 0 073 0 085 0 091	0 177 0 532 0 181 0 220 0 120 0 451	68 7 kgr 68 3 kgr
Analysis of entire peri	od		30 539 0 047 30 586	15 814	4 291	1 373 11 369 12 742	0 456 0 627 1 083		

TABLE B
Hunger period nothing taken but water, of which 4 i 1 was consumed URINE ANALYSIS

Date	Quan- tity	Spec W	C1	P2O6	N	CaO	MgO	Kr	Body Weight
July 5 July 6 July 7	2100 1210 1730	1012 1016 1014	6 108 1 219 1 677	1 785 1 954 2 197	8 526 7 996 8 910	o 179 o 196 o 398	0 074 0 102 0 106	0 130 0 416 0 294	68 3 kgr 65 kgr
Analysis of entire peri		during	9 004	5 936 4 689	25 432 1 856	0 773 3 218	0 282 0 188		
Total, urine	and fæ	es	9 004	10 625	27 288	3 991	0 470		

TABLE C
LAST PERIOD URINE ANALYSIS

Date	Quan- tity	Spec W	Cl	P2O6	N	CaO	MgO	Kr	Body Weight
July 8 July 9 July 10 July 11 July 12 July 13	710 500 530 710 1070 1320	1026 1030 1031 1019 1018 1018	2 237 2 729 3 469 5 206 5 058 5 279	1 260 1 205 1 102 1 441 1 198 2 086	8 300 8 176 7 984 9 164 6 861 9 203	0 402 0 266 0 241 0 258 0 189 0 211	0 086 0 062 0 044 0 048 0 039 0 059	0 499 0 678 0 521 0 481 0 284 0 437	65 kgr 67 3 kgr
Analysis of entire peri	ođ	during	23 978 0 056 24 034	8 292 11 808 20 100	49 788 2 956 52 744	1 567 8 296 9 863	o 338 o 529 o 837		

## TABLE D

	C1	P Os	N	CaO	MgO
Total hunger period Deduct 4 I water l consumed Real loss during hunger period	9 004 0 500 8 504		27 288 27 288	0 463	0 470 0 023 0 447

TABLE E

	Cl	P2Os	N	CaO	MgO
Total first period Total third period	30 586 24 034		58 o65 52 744	12 742 9 863	1 083 0 873
Difference	6 552	6 862	5 321	2 879	0 246
1 31 more water consumed during 1st period than in 3rd	0 159			0 147	0 017
Real retention in 3rd period	6 393	6 862	5 321	2 732	0 229

#### AUSTIN'S TABLES'

	Daily	Daily	Daily	Daily	Daily	Daily	Daily
	CaO in food	CaO in fluid	Total intake	CaO in urine	CaO in fæces	Total output	Balance
First period November 28 Average of two series of seven	j						
days each	880 gr	366 gr	1 246 gr	472 gr	787 gr	1 257 gr	oii gr
3rd series	560 gr	012 gr	572 gr	425 gr	473 gr	899 gr	327 gr

Substance taken poor in calcium Roast beef white bread grapes butter oranges chicken spring water and alkalines whereupon it hinges in these cases. During the hunger-period, when this disturbing influence ceases, we see distinctly that this bone-tissue, by its increased quantity, comes more into the foreground, and how our patient, in this way living at the expense of his body-tissues, also uses more of his increased amount of bone-tissue than normal persons." Austin's exact tables show a similar result

These tables, representing a complete analysis of the entire intake and the total output through urine and fæces during three series of seven days each, show absolutely normal conditions and no retention of lime

With the multiplicity of cases and with modern methods the pathological anatomy of progressive ossifying myositis has been fairly well cleared. No longer prevails the old definition of Virchows, who classified the pathological products as belonging under the heading of multiple osteomata and that the swellings representing such distinctive tumors always originate from the periosteum

This view had also been expressed by Eberth subsequent to his findings at an autopsy of a case of myositis ossificans progressiva which showed the ends of the muscles and their tendinous insertions ossified, the bodies of the muscles though relatively intact. This opinion was, moreover, shared at a much later date by Pincus, who denied to our malady the distinction of being a type sui generis, adding that it belonged by all means to the class of osteomata and exostoses and possessed the indubitable characteristics of a tumor-disease, its original starting-point being

A E Austin, Calcium Metabolism in a case of Myositis Ossificans, Journal of Medical Research, vol 2011, March to July, 1907, p 451

Die krankhaften Geschwuelste and op citat

<sup>\*</sup> Ueber multiple Knochengeschwuelste, Deutsche Klinik, 1862, No 9, p 91

<sup>10</sup> Op citat, 1897

the periosteum, and its casual element the hemorrhage from traumatism during birth

Mays<sup>11</sup> was inclined to compromise. He asserts the pathological process to be in the osseous system along the course of tendons and fasciæ and in the intramuscular connective tissues as well as in the loose connective tissue between the muscles, but he affirms at the same time that the entire tissue complex is not subjected to this change, this anomaly being nowhere encountered in the subcutaneous tissue, affecting only the connective tissue of that apparatus which Virchow has singled out as a seat of the multiple osteomata, "the apparatus of motion"

He was disposed to range this disease with the exostoses, although his microscopical examinations point toward an adoption of the theory of a congenital predisposition to the ossification of the intramuscular connective tissue, the fasciæ and aponeuroses

Muenchmeyer<sup>12</sup> was the first to pronounce this view, and in separating it from all cases of multiple osteomata he drew a concise picture of the malady and characterized it as a peculiar and distinctive constitutional anomaly

Cahen<sup>18</sup> pronounced, as the first, an absolute identity in the microscopical pictures of traumatic and progressive ossifying myositis and a direct causal connection between the hypertrophy or the intermuscular connective tissue and ossification. Other reliable microscopical observers confirmed, in more or less complete form, these findings

Lexer<sup>14</sup> asserts that the excessive increase of the intramuscular and connective tissue-cells and the formation of an indifferent tissue, rich in cells and profusely vascularized appearing with a simultaneous atrophy of the muscular tissue, is the forerunner of ossification. These new connective-tissue cells gradually assume large round forms and then change into cartilage cells.

Kraske<sup>15</sup> believes that those osseous neoformations, not emanating directly from the bones, are ossifications extending from the insertion of the muscles into the tendon-fibres and fasciæ and the connective tissue of the muscles. The muscles do not participat in this change, and waste away through pressure-atrophy and fatty degeneration

In Goto's<sup>16</sup> very extensive microscopical studies of his case the author arrives at the conclusion that the primary process is the hyperplasia in the fascia or aponeurosis, tendon or periosteum, also, under certain circumstances in the ligamentary apparatus

The muscular interstitial tissue, which most authors describe as the primary seat of the affection, is, according to his investigations, only secondarily invaded from the neighborhood. He would call the disease logically hyperplasia fascialis ossificans progressiva. He divides the course of the disease into three stages.

- I The stage of connective-tissue hypertrophy without inflammation
- 2 The stage of fibrous induration
- 3 The stage of ossification

The new-formed bone always shows a normal bone structure

In this paper Goto attaches no importance to the hemorrhagic extravasations found in all of his specimens excised at an early stage of the local affection. Pieces excised later still showed traces of an earlier hemorrhage, but mostly absorbed. He expresses the belief that the hypertrophy of the connective tissue takes place so rapidly and energetically that the muscular elements in spite of their elasticity have no time

<sup>&</sup>lt;sup>21</sup> Op citat

<sup>&</sup>quot;Op citat

<sup>&</sup>lt;sup>13</sup> Op citat

<sup>14</sup> Op citat

<sup>&</sup>lt;sup>15</sup> Op citat

<sup>&</sup>lt;sup>16</sup> Op citat

to escape the process of distention. They, together with the thin-walled blood-vessels, are finally torn, and thus cause the secondary hemorrhagic foci. We will see later that his experimental work for traumatic ossifying myositis shows another aspect of the importance of blood and blood-vessels for the ossifying process.

The microscopical findings in my own case, while confirming that the primary tissue change takes place in the extra and intramuscular connective tissue, add to this a hitherto unknown feature of this disease, a bone-formation in the skin—a feature contrary to all previous experience. It involves principally the corium and therefore does not definitely trespass into the ectoderm, but its independent and isolated occurrence, in even the connective-tissue layer of the skin, has not been observed before. This find more than any other proves the primary tissue affected in this malady to be the connective tissue of the mesoderm, and the secondary and passive part, the muscular tissue. The significant presence of hemorrhagic extravasations as forerunners and foci of the new-formed cartilage and bone will be considered in connection with the question of the immediate cause for the bone-formation

In considering the various causes theoretically or experimentally advanced for the explanation of bone-formation in this disease, I shall also include those for the *traumatic* myositis ossificans. While those based on the trauma itself can be easily excluded, we must recognize that the various stages in the microscopical pictures of the process of ossification are identical in both and may be profitably examined and reviewed in common

The authors writing on this subject seem, with few exceptions, to be divided into two camps, one ascribing the stimulating cause to the presence of lime deposits, the other to blood extravasation into the tissues, due to the rupture of thin-walled new-formed blood-vessels. There is lacking in both explanations the ulterior reason or proof for the presence of lime or of the free blood, the theory of metabolic lime retention being untenable in the face of the exact analyses of Burgerhout and Austin, and except in the cases of traumatic ossification none either for the extravascular blood

After a series of experiments and histological work, Berlies<sup>17</sup> arrives at the conclusion that the muscular osteoma (rider's bone) is not a tumor, but is formed in connection with the tearing off of a flap of periosteum. This is the basis of the new formation of bone, the detached flap surrounded by the muscular fibres acting as a bone-graft within the body of the muscles

A development of bone tissue may also be gained by direct transformation of cartilaginous embryonic connective tissue, or of fibrous connective tissue

Rathcke<sup>23</sup> communicates an interesting case bearing upon this latter phase of development A sailor 28 years old was hurt by the fall of a sailing yard on his right thigh A swelling resulted immediately afterward, which gradually hardened

<sup>&</sup>lt;sup>17</sup> Etude histologique et experimentale des Osteomes musculaires Arch de med experiment Paris, 1894 Tome 6, p 600

<sup>&</sup>lt;sup>13</sup> Ueber die Ursache d gelegenti Auftretens v Knorpel bei d Myosit ossif Arch f Entwicklgsmechanik d Organismen Bd vii, 1898, p 398

Extirpation some time later of this hardened mass showed an intersection of the vastus internus, with bands of interstitial connective tissue growing harder the nearer it approached the bone. In the peripheral parts the growth was a cartilaginous tissue, but near the bone it was osseous and had to be separated with a chisel Rathcke gives the explanation that where free motion exists, the tissue has to yield to changes of location and friction of the various tissue layers among each other and the cartilage adapts itself to these conditions, whilst the nearer the bone the traction and pulling is more and more prevented by its immovability, and only those cells survive which can offer the necessary resistance by their osseous transformation. This illustrates also the theory of Roux 19

Cornil and Condray<sup>20</sup> grafted entirely detached pieces of periosteum into the leg muscles of young dogs and produced thereby growth of osteomata in these muscles. The microscopical study of these and of extirpated human myosteomata convinced them that the bony tissue of these tumors grows at the expense of the connective tissue and not at that of the more or less transformed muscular tissue

John Morley's<sup>21</sup> experiments on rabbits by scraping the periosteum and crushing the overlying muscle, produced bone-growth into the muscles. His specimen and X-ray pictures show this new growth to emanate exclusively from, and remain in direct continuation with, bone, forming an exostosis extending into the muscular tissue.

Another theory that some component of the joints, evidently the synovia, plays an important part in the ossification of myositis ossificans traumatica, was advanced by Ewald. The lesion produces a tear in the capsule, some of the synovia escapes and then exercises the peculiar stimulus leading to ossification

The experiments of Fabris<sup>23</sup> were based upon similar suppositions. His observation was that most cases of myositis ossificans traumatica occur in the neighborhood of articulations. He injected synovia into the muscles of dogs, but his results were absolutely negative, not the slightest trace of osseous tissue could be found in the injected area.

Among those who advocate that the presence of lime is the important cause of ossification, Cohn<sup>24</sup> believes that in a fair number of cases a chronic mechanical irritation by lime alone may lead to ossification (in blood-vessels)

Marchand<sup>25</sup> asserts that genuine bone may be produced by connective tissue everywhere where sufficient lime salts are available, \*e, where calcification has preceded Without the presence of lime no bone could be found, in spite of the most energetic hyperplasia of connective tissue

Rohmer<sup>26</sup> believes that the first condition for the production of bone is the new formation of a highly vascularized connective tissue, and the second the presence of lime

Gesammelte Abhdign Ueber Entwickelgsmechanic, Bd 11, No XVIII Leipzig, 1895

<sup>&</sup>lt;sup>20</sup> Sur le mode de developement des osteomes musculaires d'origine traumat Bulletin de l'Academie de med Paris, 1907 Pp 597-600

<sup>&</sup>lt;sup>21</sup> Traumatic intramuscular ossification British Medical Journal, Dec 5, 1913, p 1475

<sup>&</sup>lt;sup>22</sup> Zur Aetioligie d Myos ossif traumat Zentralbl f Chir 1910, No 22, p 771

<sup>&</sup>lt;sup>23</sup> Fabris Sulla genesi della miosite ossificante Gazetta degli Ospedali e della Cliniche, 1911, No 42, p 443

<sup>&</sup>lt;sup>24</sup> Cohn Ueber Knochenbildg in d Arterien Virch Arch Bd 106, 1886

<sup>&</sup>lt;sup>25</sup> Marchand Verholgn d deutsch Pathol Ges Ber ueb d 2 Tag Aachen 17-20, September, 1900

<sup>&</sup>lt;sup>20</sup> Ueber Knochenbildgn in verkalkten endocarditischen und endarter Heerden Virch Arch, Bd 166, p 13

A similar view as to lime has been entertained by Pollak<sup>27</sup>, who observed cases of heterotopic bone-formation in the lungs. It always occurred around calcified necrotic parts. His case (No 21) showed an additional ossification of the stylohyoid, case No 24, exostoses on the lumbar vertebræ

Roepke<sup>33</sup> joins in the conclusions that the presence of lime salts within a traumatically inflamed connective tissue furnishes the irritation and cause for bone-formation

Georg B V Gruber<sup>29</sup> emphasizes again the absolute identity in the microscopical pictures of slides of traumatic myositis ossificans cicumscripta and myositis ossificans progressiva, and adds that wherever young and very vascular connective tissue meets with previous lime deposits an osseous formation is possible without any relation to periosteum. Such has been observed in blood-vessels, lymphatics, glands, brain, liver, kidneys, vas deferens, etc. He also mentions the possibility of secondarily encysted blood or lymph deposits being the source of lime for bone-formation. In a previous paper<sup>20</sup> the same author arrived, among others, at the following conclusions. "That the periosteal genesis in myositis ossificans traumatica is improbable and is absolutely excluded except in cases where the muscle-bone is in direct communication with the skeletal bone, and that the ossifications of the muscles are caused by the united action of young cellular connective tissue meeting the deposits of calcium, or of being stimulated to ossification by its presence in the tissues

"In order to decide the problem of the genesis of muscular ossification or to solve that of heterotopic ossification in general, the questions regarding the calcium metabolism and the calcification of tissues must be answered. Until now the acceptance of a certain individual disposition to such ossification cannot be dispensed with entirely"

Dibbelt<sup>M</sup> drew attention to the difference in the forming of bone between carnivorous and herbivorous animals, dogs instancing the difficulty among the carnivorous, rabbits the case of the herbivorous. He attributed these diversities to the high calcium metabolism of the herbivores, and supported this theory by animal experimentation. He fed rabbits on food poor in calcium and caused the formation of fibrous tissue in place of bone, the addition of calcium to the food effecting a metaplastic change of tissue into bone

That free blood acts as a factor in the bone-producing process has been very frequently and persistently claimed by many authors

Cahen<sup>82</sup> claims this in his paper where he asserts as the first, that the microscopical picture of myositis ossificans traumatica is identical with that of progressive In his case the hemorrhage caused by the trauma marked the place of origin of the later ossification

E Cordillat<sup>23</sup> reports the case of a young soldier, 21 years, entering a cavalry regiment, who, between November 24, 1894, and January 19, 1895, rode altogether about fifteen miles, and who presented himself on the latter date with an ecchymosis, the size of a dollar, on the left leg posteriorly, and a hard, bony mass at the inside of the femoral vessels occupying the entire middle adductor, a length of 17 cm, with

<sup>&</sup>lt;sup>21</sup> Ueber Knochenbildgn in der Lunge Virch Arch, Bd 165, p 129

<sup>23</sup> Z Kenntn d Myositis ossif traumat Arch f klin Chir, Bd 82, p 81

Westere Bestraege z pathol Anat d umschrieb Muskelverking, nebst Bemerkgin z Myositis ossif ueberhpt Mitth a d Grenzgb d Med and Chir, 1914, Bd 27, pp 762-786

<sup>&</sup>lt;sup>80</sup> Ueber Histol & Pathogen d circumscript Muskelverkng Jena, G Fischer, 1913 <sup>81</sup> Beitraege z Histogenese d Skelettgewebe & ihrer Stoerungen Beitraege z pathol Anal & z allgem Pathologie, 1910 Bd 48, p 147

<sup>22</sup> Ueber Myos ossif Deutsche Zeitschr f Chir, Bd 31, 1890, p 372

Osteome bilateral du moyen adducteur Arch d Med et de Pharmac. militaires, 1895 Tome, 26, p 427



Fig 20 —Osteoblasts participating in bone formation on inner side of ring and along branches a bone ring, b osteoblasts (enlargement of Figs 19 and 30 A)



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Fig. 21 — 1 Osteoblasts on both sides of ossifving branches a branches (enlargement of Fig. 19), b osteoblasts B Osteoblasts on both sides of ossifving branches (enlargement of Fig. 21A) a osteoblasts, probable origin of osteoblasts from conjoined transformed fibroblasts b branches

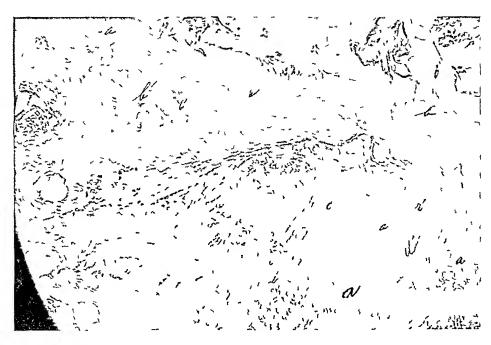


Fig 22—Inner part of ring cartilaginous outer osseous—Erythrocytes aiding bone formation a erythrocytes apparently entering bone formation, a' erythrocytes in close opposition to youngest layer of ring changing shape to spindle form, b' cartilaginous spot, b bone ring

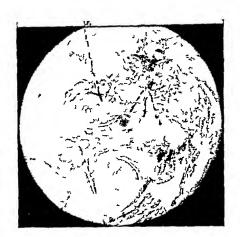


FIG 234



Γ1G 23B

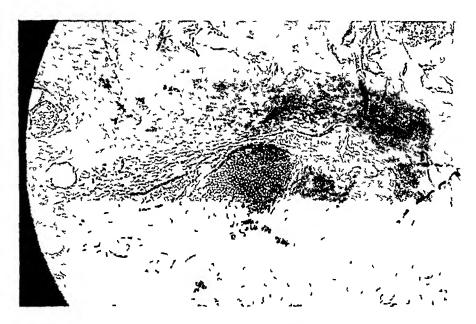


Fig. 23—Erythrocytes apparently entering into bone formation and remainder of cartilaginous tissue next to osseous formation in ring. A a, erythrocytes apparently aiding bone formation, b, cartilaginous spot (oc. II obj. 16). B a, erythrocytes apparently entering bone formation, b cartilaginous spot (oc. VI obj. 8). (Enlargement of A) C a erythrocytes apparently changing into fibroblasts, b, cartilaginous spot (oc. VI, obj. 4).

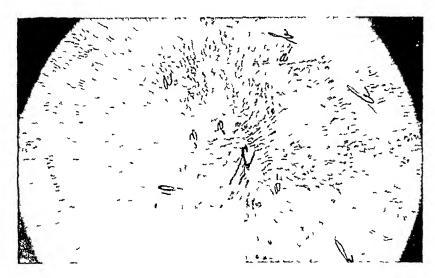


Fig 24—Apparent erythrocyte participation in bone formation of branch and ring a crythrocytes, a', change of form of erythrocytes to spindle shape as they get into contact with the youngest osteogenetic layer of the ring and branches, b bone ring, c branch (very early stage)



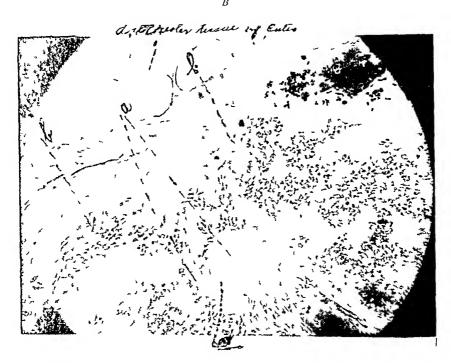


Fig 25—Fungus and finger shaped inner branches with osteoblasts (a) and apparent erythrocyte participation in forming branches and ring (b and c) A a branches b ring, c osteophytes (oc II obj 16) B a erythrocyte in branches b erythrocyte in ring c beginning formation of branch, d areolar tissue (oc II obj 4) e as ostroblasts

Fig 26 — 4, Apparent erythrocyte participation in building of branches in very early stage of formation

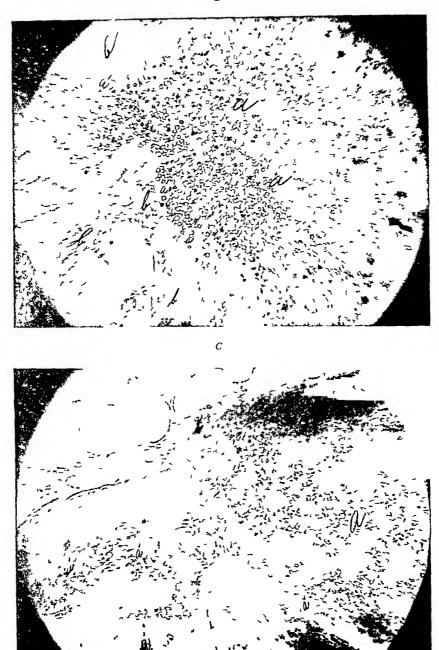


Fig 26—B Apparent ery throcyte participation in building of branches in very early stage of formation (enlargement of Fig 26 C) a erythrocytes, a' same entering into building of branches b branches in very early stage of formation C Apparent erythrocyte participation in building of ring and branches in early stages of formation somewhat later than Fig 26 B a erythrocytes a' erythrocytes\_in apparent participation of building of ring and branches in early stage of formation, b ring

a spur about 3 cm long at its upper part. He was under daily observation until February 15, 1895, when the surgeons discovered an osteoma in the right adductor medius. It had formed unbeknown to the patient, occupying the same position as on the left and evidently from the same cause

Duems<sup>84</sup> expresses his belief, founded on the observation of his cases, that the irritation of the connective tissue from the hemorrhagic infusion following the trauma is responsible for the ossification

Bier<sup>85</sup> voices a similar opinion, accusing directly the hemorrhage of being the irritant for bone-formation

Stempel<sup>80</sup> excised pieces of muscles from a case of myositis ossificans progressiva. His microscopical examination of the early stages always showed a hypertrophy of the fibrillary tissue separating the muscular fibres and an intramuscular hemorrhage, and although he never detected an increased cell infiltration or primary hypertrophy without hemorrhage, this author expresses the opinion that the excessive connective-tissue growth as the primary factor in the process causes the hemorrhage by pressure and later the ossification

Steinert<sup>37</sup> observed ossification of muscles after hemorrhages into them, with patients whose limbs were paralyzed from cerebral apoplexy. In some of these cases the connection between hemorrhage and ensuing ossification is most striking, in a few others only very probable. In one of the cases a disposition to hemorrhages existed.

In their experimental work Sacerdotti and Frattin<sup>35</sup> found a nearly constant bone-production with bone marrow in kidneys of rabbits after ligation of renal blood-vessels, and consequent hemorrhagic necrosis and ossification throughout the organ. The necrotic tissue is riddled with blood-extravasations, and these give rise to ossification.

Berndt<sup>89</sup> found, in a free ossified muscular tumor extirpated twelve days after a trauma, a hemorrhagic extravasation entirely permeating the muscle and periosteum

In his two excellent monographs on myositis ossificans progressiva and myositis ossificans traumatica Goto pleads for the recognition of an essential difference in the part taken by the hemorrhagic extravasation of changing into the ossifying tissue of the former disease from that in the latter. Although encountering in all of his early excisions of invaded tissues, either of the progressive or the traumatic, or of the experimentally produced forms of myositis ossificans, the characteristic hemorrhagic extravasation into the affected territory, he considers the hemorrhage of the progressive form a secondary feature induced by the hyperplasia of the connective tissue, which is supposed to finally tear the muscular fibres, together with the small, thin-walled blood-vessels, and thus cause a secondary hemorrhage, an explanation already advanced by Stempel 12 In the traumatic form, however, Goto

<sup>&</sup>lt;sup>84</sup> Deutsche militaeraerzti Ztschr 1887 No 16, p 325

<sup>&</sup>lt;sup>85</sup> Beobachtungen ueber Kochenregeneration Arch f kl Chirurgie Bd 100, p 91 <sup>80</sup> Op citat

<sup>&</sup>lt;sup>27</sup> Ueber d sogen Myos ossif & verw pathol Verkngsproc insbes bei org Nervkikhtn Mithlg a d Grenzgeb d Med & Chir Bd 21, 1910, p 513

<sup>&</sup>lt;sup>28</sup> Sulla produzione eteroplasto dell' osso Ricerche sperimentali Giornale della Academ di Med di Toreno Vol vii, 1901, fasc 12 & Virch Arch 1902, Bd 168

<sup>30</sup> Arch f kl Chirurgie Bd 65

<sup>&</sup>lt;sup>40</sup> Patholog & Anatom-klin Studien ueb d sogen Myositis ossif progr Arch f klin Chir Bd C, p 730

<sup>&</sup>lt;sup>41</sup> Die sogen Myositis ossif circumscripta traumatica Eine chirurg experimentelle Studie Mitthlgn aus d mediz Fakultaet d Kais Univ Kyushu, Fukuoka, Japan, Bd 1, 1914

<sup>42</sup> Op citat

recognizes the primary part of the hemorrhage, and the microscopical examination showing no difference between the two, he considers hemorrhages in the latter the primary cause and essential for bone-growth in consequence of the trauma, and although he constantly found their traces as well in fresh attacks of myositis ossificans progressiva, they are considered by him as a secondary trait only in this disease

Goto employed for his experimental production of myositis ossificans indirect traumatism of the periosteum by hammer blows upon a portion of the femur, only thinly covered by muscle, and transplantation of periosteum into the muscular substance by either pedicled or free flaps, or of fine pieces chopped in physiological salt solution. They were all successful. He also tried hammer blows, and other traumatisms, with and without intramuscular injections of small quantities of blood, and finally the method of G. Koga<sup>43</sup>—repeated intramuscular injections of 1 per cent solution of chlorate of lime, 3 cm to the kgr weight of rabbit. Of this last series of experiments, solely the ones with chlorate of lime injection showed ossification centres, the ones with the injections of blood alone showed calcification only

The excisions and examination of these latter took place only thirteen days after the injections, whilst those of the chlorate of lime series were allowed to stay thirty and more days. The question if a longer interval between injection and excision of the blood injections would have given results of ossification must remain unanswered at the present time. The same experiments on guinea pigs showed early X-ray shadows

Duems-Vulpius" approach this quest from an experimental as well as clinical standpoint. Their experiments and their casual observations of these ossifications always showed hemorrhagic extravasations as their precursors

Among the latest publications on heteroplastic ossifications, two notable papers, Moshkowitz45 "On the Relation of Angiogenesis to Ossification, etc," and George W Outerbridge's46 "Non-teratomatous Bone-Formation in the Human Ovary," require special attention. Moshkowitz quotes the older Rabl-Schulte doctrine of the specificity of endothelium, which takes it from the series of mesenchymal derivatives and separates it absolutely from the blood should this prove to be of mesodermal origin. Consequently, thinkers who support this view have seen the importance of assigning an entodermal origin to both blood and endothelium. He then endorses the modern theory of angiogenesis (first proposed by Rueckert and Mollier) that blood-vessels form from clefts and spaces within the mesenchyme bounded by the indifferent mesenchyme cells The clefts and spaces enlarge, fuse together to shape the blood-vessels while the lining mesenchyme cells flatten and form the endothelium The microscopical specimens of Moshkowitz lend great force to this theory He ascribes to blood-vessels the important part in the process of ossification in bringing a dead or mert tissue into heteroplastic activity, and in describing further how fibroblasts later become endothelium he shows that normal and pathological ossification are based upon identical features

<sup>&</sup>lt;sup>43</sup> Koga-Kyota Igaku Zassı Bd IX, 1912, h 2 and 3

<sup>&</sup>quot;Op citat

<sup>&</sup>lt;sup>43</sup> The Relation of Angiogenesis to Ossification Based upon the study of five cases of Calcification and Ossification of the Ovary Johns Hopkins Hospital Bulletin, No 301, March, 1016

<sup>46</sup> American Journal of the Medic Sciences, No 531, p 868, June, 1916

In his conclusions, he reiterates "the importance of circumscribed lime deposits for the formation of primary Haversian canals, accomplished by the genesis of an active mesoblastic tissue, both around the surface and within the interior of such deposits. This mesoblastic tissue is derived from the adjacent blood-vessels and the predominant activity in the development of new blood-vessels."

The development of new blood-vessels affords the keynote to the interpretation in terms of cellular ontogeny of the process of ossification. The histological constituents which enter into the formation of new blood-vessels are the progenitors of all the histological compounds of osseous tissue. In other words, blood-vessels, osteoblasts, bone cells and marrow (in large part at least) are merely differentiations of the mesenchymal cell-unit. After having demonstrated that his specimens furnish strong corroboration of the adaptive or mesenchymal theory of angiogenesis, and to the theory of the non-specificity of endothelium, he adds that ossification does not occur without preliminary calcification, and calcification occurs only in dead tissues. We quoted Moshkowitz more extensively, as our own specimens show many resemblances to his, after calcification has occurred. Outer-bridge gives virtually identical pictures but does not enter into their interpretations, but simply chronicles the calcification and final ossification.

Although Haga and Fujimura<sup>47</sup> do not ascribe a basic importance to the primary hemorrhage in the traumatic myositis ossificans, the reports of their microscopical findings in extirpated specimens of their cases variously mention in every one the presence of blood-extravasations, as "capillaries in the intermuscular connective tissue are torn and extravasation of blood has taken place numerous and large hemorrhagic extravasation and mighty development of new capillary vessels goodly sized blood extravasation in the intramuscular connective tissue here and there blood extravasates and neoformation of capillaries "and thus permit a different view of their importance from that of the authors

Van Arsdale48 published a very interesting and important case of an ossifying hæmatoma, important for this question of participation of free blood in the act of ossification A young man, 22 years old, received about the middle of April, 1891, severe blows on his right arm. The region immediately below the insertion of the deltoid was the seat of a large, soft fluctuating tumor, showing an increase of circumference over its fellow of 10 cm. The skin over the swelling was bluish and the parts tender on pressure When seen again, May 20, the circumference of the right arm was diminished 6 cms, tumor of bony hardness throughout and apices harder than middle Presented on May 27 to Surgical Society of New Operation June 22 External tumor 9 cm York, diagnosis, ossifying hæmatoma and 3 cm broad or high, external coat or shell nearly 11/2 cm thick, contains cavity filled with partly coagulated blood Bony hardness of the wall most marked over periphery of tumor Induration then gradually decreased toward central cavity The same course, from calcification to ossification, as seen in humans, was

<sup>&</sup>quot;Arch f kl Chir Bd 72, Hft 1

<sup>48</sup> Annals of Surgery, 1893

observed in the one case published as such from animal pathology Lorge<sup>40</sup> dissected an anatomy horse which showed the symptoms of progressive myositis ossificans. The horse showed in the connective tissue surrounding the smaller muscular bundles (perimysium internum) a great number of fine needles resembling cement, which made a noise when the knife passed over them. The affected muscular fibres had a pale yellowish color, they were atrophic and their contents partly fattily degenerated

The diseased muscles were distributed all over from head to feet. In the tongue the mass could be kneaded with the fingers, in other places it was so firm that it could be crushed only with difficulty. Microscopical examination showed that the normal striation of the diseased muscles had disappeared and in their place were granular or dark dots composed of bone cells. The external cellular sheath of the muscle did not show anything of a pathological calcification. According to the views of Lorge, "the calcareous deposit in the inner sheath of the muscle was the first, the atrophy and fatty degeneration of the muscle fibre the second stage of a disease, which is rarely observed with humans and has been named progressive ossifying myositis by Professor Dusch, of Heidelberg."

Another animal case not yet published is one observed by Prof Dr K F Meyer, of the Hooper Foundation for Medical Research of Medical School, University of California While showing my slides to the Doctor he was reminded of the case of a dog examined by him in Philadelphia in 1912 as Director of the Pathological Laboratory, Pennsylvania State Live Stock Sanitary Board, University of Pennsylvania From comparing our notes and pathological findings we both came to the conclusion that this dog, the exact diagnosis of whose disease had been rather baffling, had been suffering from myositis ossificans progressiva, and Doctor Meyer was kind enough to permit me to incorporate his hitherto unpublished manuscript in my treatise. I give it largely in its original form, with a few changes made by me relative to its new viewpoint and submitted to and approved by Doctor Meyer.

In November, 1912, through the courtesy of Doctors Cunningham, Hoskins and Jarrett, of the Pennsylvania State Live Stock Sanitary Board, a dead setter dog was sent into the Pathological Laboratory which showed on all four legs a most remarkable anomaly which had developed gradually Unfortunately, the dog had died the day previous, and therefore the carcass when brought to autopsy was in a fairly advanced stage of decomposition Before giving the autopsy findings, I will briefly relate the clinical history given to me by the owner of the dog (Doctor Cunningham)

Setter dog, male, was born in May, 1909, and was one of a litter of fourteen Some of the pups were killed accidentally by the mother Seven were raised were all extremely nervous At the age of four to five months the pup in question was lame in the left hind leg It was found that the left hock region was swollen and on palpation very tender The animal was treated with Fowler's solution for about one month, at the end of which time the swelling disappeared and the dog developed normally to a typical English setter and at the age of one year won two first prizes At the age of eighteen months the dog became listless, would lie in the corner and refused to play, which was strange, as the dog had always shown unusual vivacity At the age of nineteen months the swelling on the hock again appeared, was tender on palpation and soon extended above and below the hock The dog became extremely lame and was most of the time dragging his legs under him. It was again treated with Fowler's solution, and about two months later a similar swelling started in the right hock, and at the age of twenty-two months both hind legs were enormously enlarged A careful examination revealed that the joints were absolutely

<sup>&</sup>lt;sup>49</sup> Annales de Medecine veterinaire, publ a Bruxelles XXme annee, Mars-Mai, 1871, ref Repertorium d Thirhlkde, Hering

normal The general condition of health was perfect, the appetite was good, no fever was ever noticed

In the spring of 1912 a similar swelling started gradually, beginning on the metacarpus and elbow on the front legs. The dog started a very troublesome cough This condition remained the same until November, 1912. He was able to walk by dragging his legs after him, but he had always to be assisted when walking up or down stairs. Two days before his death the cough was very bad and temperatures from 103 to 106 were noted. He died with the symptoms of heart paralysis November 19, 1912.

The autopsy was performed by me on November 20, 1912, and the following is a condensed report of the essential findings only

Setter dog, male, 2½ years old Emaciation, all four legs hard, tremendously enlarged and heavy Fat tissue has nearly disappeared Muscles on extremities atrophic, pale and ossified Along the extremities the skin can only be removed with difficulty on account of a heavy layer of dense, hard, whitish connective tissue Along the shoulder-blade at the insertion of the muscles, hard, nodular, fibrous, callous-like connective-tissue layers

In both pleural cavities there is a small amount of reddish fluid Costal pleura slightly reddish

The right apical lobe is attached to the costal pleura by several broad connective-tissue bridges. All lobes of the lungs are ædematous and soft. The right upper lobe shows a tumor size 15½x19½ cm distinctly protruding above the surface of the healthy lung tissue. Its color is whitish and in certain places grayish

The consistency of this tumor is dense and hard. On section there is a connective-tissue capsule of about 6 mm, a whitish, yellowish tissue meshwork, which contains many cheesy, pus-like areas. The bronchi leading to this portion contain granular pus and a few superficial ulcerations. All the other lobes of the lungs contain in the bronchi a serous reddish fluid. The tissue is soft and friable

The left and right bronchial lymph-nodes are enlarged and contain numerous yellowish nodules, which are in places also cheesy. In the trachea and bronchi a small amount of granular mucus intermixed with pus flakes. The vocal cords and the epiglottis are somewhat thickened and hard

An examination of the extremities revealed the following conditions. The left and right thoracic limbs show the length of the ulna about 22 cm, a circumference of 22½ cm and a thickness of 6 cm. The elbow and carpal joint are immobile. The metacarpal and interphalangeal joints are, under restriction, mobile. On incision the enlarged parts of the ulna show a fibrous, nodular, gritty, bone-like material. Both pelvic limbs are extremely enlarged, but remarkably flattened. The following figures will indicate the conditions.

The length of the right tibia is 25 cm. From the middle of tarsus to the end of the third toe, 18 cm. The diameter of the oval-shaped tibial circumference is 8 cm, and 6 cm thick, and is considerably flattened in the middle. The circumference is 21 5 cm. The circumference of the metatarsal bones is 25 cm, and the diameter of the region of the tarsal bones is 10 cm. The second toe has a length of 3 cm and a circumference of 5 cm, and is extremely plump. The structure of the subcutis is the same as that described for the fore-limbs

No swellings or enlargements of any kind were noticed on the head, around the spinal column or the tail

The left thoracic and the right pelvic limbs, together with the entire skeleton, were carefully macerated. The right thoracic and left pelvic limbs were fixed in Mueller's solution. The tumor in the apical lobe was fixed in formalin.

The maceration of the skeleton revealed the following pathological changes

The supraoccipital and the condyloid fossa show slight roughening The condyles

of the mandible show small, wart-like roughenings All the bones of the head are somewhat porous

The left shoulder-blade is light when compared with those of normal dogs, somewhat porous, but normal in shape. The posterior angle shows plump, thick, hard swelling, size 2½ x 4 cm. (See plate 1, 2, 3). The edges are nodular, wart-like. The acromion is enlarged, flattened and porous. The scapular notch shows small, wart-like, spongy exostoses. The scapulo-humeral joint is absolutely smooth and normal. The humerus is normal in length, but extremely plump, shows on the crest a flat, leaf-like growth of bone tissue, which extends over the shaft, leaving a space free for the atrophic biceps muscle. Both the external and the internal condyloid crest, the external and internal condyle, the olecranon fossa, are covered by heavy (3 cm.), thick, spongy, wart-like osteophytes, resembling on the internal condyle the picture of a sponge. Both articular ends of the humerus are normal. The bone tissue is extremely spongy and soft. Above the condyles is a small hole connecting the coronoid fossa with the olecranon fossa and is caused by osteophytes on the proc anconeus of the ulna.

Both ulna and tibia are covered with most luxuriant osteophytes. Their length appears about normal as compared with dogs of the same age. The existence of the ulna can only be determined on the proximal joint ends, where the radius is still separated from the ulna by a small groove. Otherwise the entire ulna is buried in the mass of new bone tissue. The thickness of this neoformation examined from the anterior side is about 5½ cm, spongy, irregular masses of bone tissue surround the entire radius, leaving only on the internal side a round groove for the localization of the deep flexor and the flexor carpi internus. The joint ends are entirely invisible when mounted, but show distinct pseudo-arthrosis of the osteophytes. A similar pseudo-arthrosis is seen at the proximal end of the osteophytic growth and the osteophyte above the coronoid fossa.

The carpal bones are invisible on account of the masses of osteophytes. On the posterior view they can still with some difficulty be distinguished, as there the osteophytes have left a flat, oval channel for the passage of the flexor tendons. The metacarpal bones are uniformly covered in the anterior portion by an arborescent wart-like growth of osteophytes. The third and fourth bones are separated by a cleft. From the fifth and the first metacarpal bones the osteophytes grow over the posterior part of the metacarpus, forming the roof of the channel mentioned above. The osteophytes on the metacarpal bones show pseudo-arthrosis with the osteophytes of the carpal bones, the ulna and the radius. We have two masses of osteophytes, therefore, those of the radius and ulna and those of the carpal and metacarpal bones, which are connected by joints

The first phalanges are plump, those of the fifth, second and first digits show the osteophytes on the external side. The second phalan of all digits is chunky and shows wart-like osteophytes growing on the back of the phalan. The wing and coronary ridge on the third phalan are also plump and show crest-like osteophytes surrounding the entire bone. Only the ungual surface is entirely smooth, somewhat porous. All of the joint surfaces are smooth and unaffected. The volar sesamoids were lost during the process of maceration.

The pelvis appears normal, is somewhat porous, around the psoas tubercle and the iliopectineal line there are several wart-like osteophytes

The femur is of normal length, shows similar conditions to the humerus, the proximal and distal joint-ends are normal

The patella and the sesamoid bones are covered with osteophytes which are connected by pseudo-articulations

The tibia and fibula are remarkably enlarged and show most of the lesions that were observed in the thoracic limb. Here also a space is left open for the flexor tendons, the lesions on the tarsus and metatarsus and digits are nearly identical with those just described for the thoracic limb, with the exception that there is a marked

lateral compression, probably due to the fact that the dog was lying constantly on the hind legs

Most of the lesions are therefore seen on both extremities. They are characterized by extremely massive apposition of bone which is located around the compact masses of the bones, selecting frequently the places of the insertion of the tendons

A chemical analysis of some of the osteophytes on the radius, and, for comparison, from the shoulder-blade, was made I am indebted for the analysis to Dr John Marshall, of the University of Pennsylvania

CHEMICAL COMPOSITION OF DI	KIED	RONE
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	Normal	Exostosis	Shoulder-blade
Calcium phosphate, Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> Magnesium phosphate Mg <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> Carbonate, fluoride, and chloride of calcium Organic matter (ostein) Water at 105°-120° C	57 35% 2 05% 3 45% 33 30%	53 98% 2 75% 3 04% 31 91% 8 32%	52 71% 2 18% 3 32% 32 58% 9 21%

By the above table it is shown that the minerals are uniformly reduced as well as the ostein. A slight increase of water is noted and conditions are prevailing here which resemble somewhat those found in osteomalacia

The microscopical examination of sections of the lung tumor, stained with hæmatoxylin, eosin, Van Gieson, etc., show

A thick layer of connective tissue containing a few capillaries Below this layer is seen the tumor tissue of alveolar or papillomatous epithelium. Connective tissue septa of varying thicknesses form a net-like stratum, the free spaces, tubules or alveolæ are coated by single or stratified layers of fairly regular epithelial cells and contain debris, desquamated cells and coagulated masses

The size of the alveolæ is varying, they are mostly tubule-like, in some places they are glandular and resemble adenomatous or papillomatous structures. The epithelial cells are squamous, with large vesicular nuclei, sometimes they are narrow and cylindrical, in most alveolæ they are in single layers. Most of the cells have smooth contours, some, however, show filament-like protoplasmatic projections. The type is apparently one of metaplastic pulmonary epithelium. It is impossible to determine whether alveolar epithelium of the lung, or whether metaplastic columnar epithelium of the bronchial lining is the substratum from which these tumor cells have developed. In specially stained sections no mucin-like material could be seen, so that I feel justified in excluding the possibility of the tumor cells having originated from the mucous bronchial glands.

In the depth of the tumor the tissues are to a large degree necrotic and consist of material which stains deeply with eosin, some areas of liquefaction are distinctly seen as indicated by the presence of numerous leucocytes and lymphocytes

The lymph-nodes showed the same papillomatous arrangement of the same metaplastic epithelial cells. A careful search for tubercular lesions was negative. The lung tumor can therefore be diagnosed as a primary lung carcinoma with secondary metamorphosis and metastases in the bronchial lymph-nodes. It was impossible to determine if the tumor was of alveolar or of bronchial origin.

Sections of the bone proliferations which were fixed in Mueller's solution and decalcified with nitric acid and embedded in celloidin show on the left fibula (for example) that the entire bone material directly under the derma is covered by fibrous connective-tissue layers. The osteophytes in form of lamellæ and trabecula are rich in blood-vessels and Haversian canals. Some of the walls of the blood-vessels are abnormally thick. Fibrils of connective tissues cross the muscles in different directions and compress the fibres. Between the osteophytes is a soft, succulent connective-tissue mass.

The compact substance of the fibula is extremely reduced in thickness—and it is difficult to realize what is originally bone and what is osteophyte. The Haversian canals are very remarkably enlarged, one notices groups of osteoclasts and giant cells scattered irregularly. The process here is of the usual character of bone resorption.

Below this zone similar trabecules grow into the marrow. The structure and shape are similar to the periosteal osteophytes. Dense connective-tissue fibres show layers of osteoid tissue which is surrounded by spindle-shaped cells resembling osteoblasts. The process of active bone apposition is quite apparent. Lack of comparative material prevented a further study of this enchondral ossification.

In view of a recent revision of the data of this case I do not doubt it to be one of myositis ossificans progressiva in the dog The clinical history is an exact counterpart of many of the typical histories of human cases in the foregoing compilation (vide cases 15, 17, 23, 25 and many others), the more extended ossification having been arrested by an early death due to complication with the carcinoma in the lung The pathological changes in the osseous system are significant of the disease. The ossification along the muscular tracks and insertions involving and supplanting these structures, the comparative freedom of the articulations, together with the spongious character of the new bone formation, are all features of this disease A very characteristic symptom marking this case undeniably as one of myositis ossificans progressiva is the microdactylic state of the thumb of the photographed thoracic extremity The end phalanx was lost in the process of maceration, but the first metacarpal is less than half of the normal size and the first phalanx also is considerably shortened. At the time of the autopsy the diagnosis of myositis ossificans progressiva was not taken into consideration and therefore no attention was paid to the fingers and toes of the other extremities, but the photograph of the macerated foot shows the condition distinctly so as to remove all doubt, at least as to this extremity very rare similar observations in the literature of animal pathology appear from this viewpoint in a new light

In 1890, Kitt<sup>50</sup> observed a case which, according to his description, resembles my specimens in many respects. The exception was the exceedingly prominent lesions on the mandible very frequent in human cases of myositis ossificans progressiva. Perhaps masmuch as the dog had been destroyed in perfect health, the lesions on the limbs could not develop to the same degree as those seen in the case under discussion. The dog was one year old. Kitt<sup>51</sup> explained the condition as an abnormal diathesis of bone formation, and masmuch as the ossification started at the insertion of the muscles, he diagnosed his case as a multiple myopathic hyperplasia of the bones.

Lienaux<sup>52</sup> saw two old dogs with distinct enlargement of the thoracic and pelvic limbs. He could autopsy, however, one animal only. The pictures and descriptions correspond with my observations only that the extent of the process is a less marked one than in my case. In another case, of which he found only the skeleton in the

<sup>&</sup>lt;sup>50</sup> Kitt Lehrbuch der pathologischen Anatomie der Haustiere, I, 1910, 4th edit, p 388

<sup>&</sup>quot;Symmetrische multiple Hyperostosis & Exostosis bei einem Hunde tahresbericht der kgl tierarztlichen Hochschule, 1890

Lienaux Apropos de l'osteitisme, osteite deformante du chien Ann de medecine véterinaire Mars, 1899

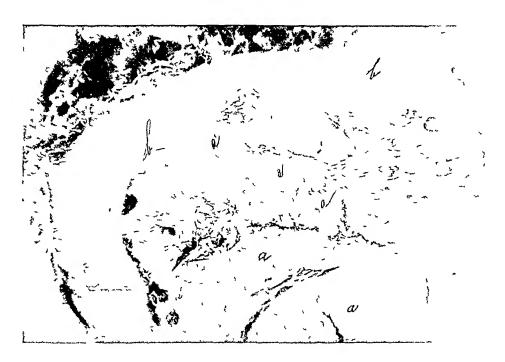


Fig 27—Apparent erythrocyte participation in bone formation and differentiation of osseous and cartilaginous parts of ring a, Erythrocytes, b, cartilaginous part of ring, c osseous part

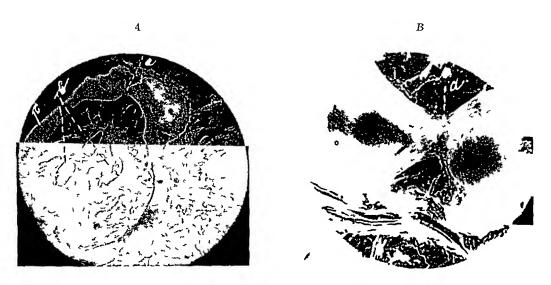
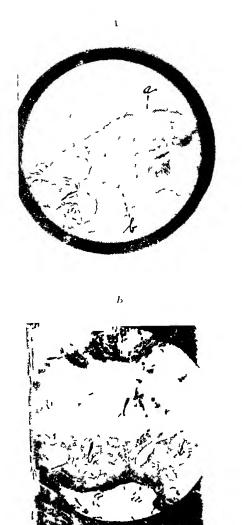


Fig. 28—Interior osseous branches and islets forming and a connective-tissue bridge between bony ends of ring A a, connective tissue bridge, b branches and islets, c outer ring (oc 6 ob) 16) B, a connective-tissue bridge of 4 (oc 6 ob) 4)



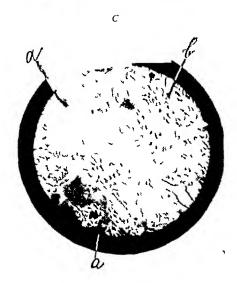
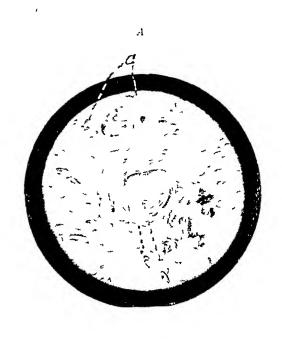


Fig 29—Bone and bone marrow 1 a outer ring b bone marrow (oc 2 obj 1a 7) B a outer ring b bone marrow (oc 2 obj 16) C a branches b fibroblasts and capillaries (oc ,2 obj 4) (En largement of inner part of A)



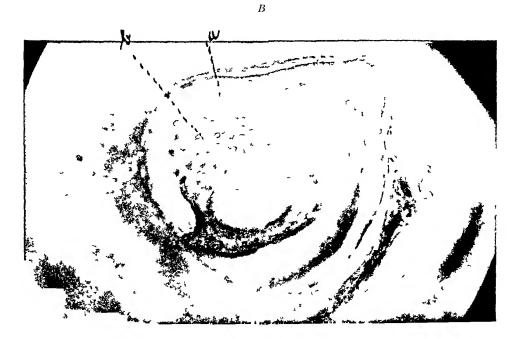


Fig. 30 — Cartilaginous development of bone Cartilaginous tissue at inner border of osseous ring A a, ossified outer part b cartilaginous part, c epidermis (oc 2 obj 16) B a ossified part, b cartilaginous part (oc 2 obj 8) (Enlargement of 1)

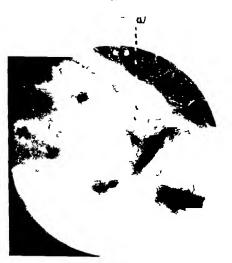




Fig. 31—Inner branches with erythrocyte participation A a erythrocytes entering in bone formation (oc 6 obj 16) B a erythrocytes in same place (oc 6 obj 4) B Branches of later stage of formation with apparent erythrocyte participation (enlargement of A) a erythrocytes, a' erythrocytes in participation of building of branches b branches

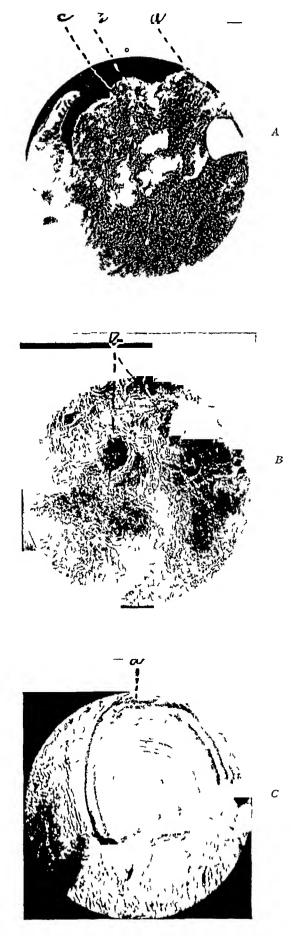


Fig. 32—Solidified bone and primary hemorrhage both near each other close to epidermis A as solidified bone, b primary hemorrhage, c expidermis (oc. 2, obj. 2\*) B b primary hemorrhage (oc. 6 obj. 16) C a solidified bone (oc. 6 obj. 16)

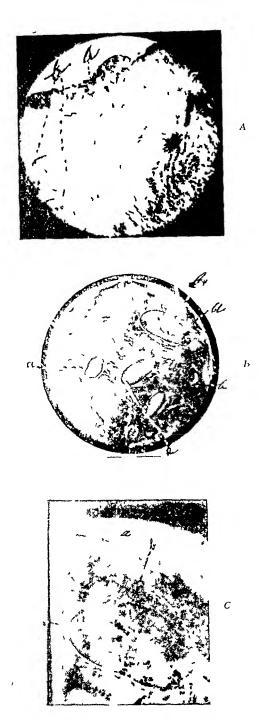


Fig. 33 —Partially solidified bone with central remainder of erythrocytes close to epidermis A a epidermis b bone with erythrocyte centre (oc 2 obj a\*) B a epidermis b bone with erythrocyte remainder (oc 2 obj a\*) C a epidermis b same bone c erythrocyte remains (oc 2 obj a4)



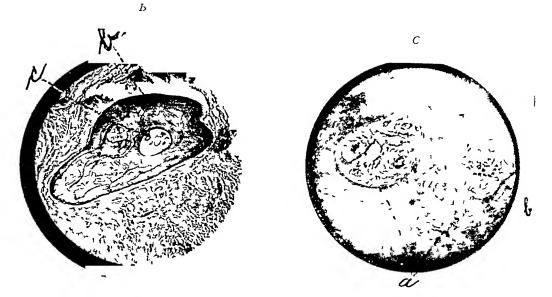


Fig. 34 —Solidifying bone with remainder of erythrocyte central enclosure. A a epidermis, b bone, c erythrocyte central enclosures (oc. 2 obj. 1\*). B b bone c erythrocyte central enclosures (oc. 2 obj. 16). C a erythrocyte remainders, b erythrocytes (oc. 6 obj. 4).



Fig. 34 -D Bone in late stage of solidification with small remainders of hemorrhagic enclosure bone layers b remainder of hemorrhagic enclosure (Enlargement of Fig. 34 C)

museum at Brussels, were seen similar symmetrical exostoses. These cases were diagnosed by him as ostitis deformans. Ten years later, on account of some further observation along the same subject and influenced by the work of Alamartine<sup>53</sup>, the same writer revised his early conception of the bone lesion and considered it to be identical with the so-called "osteo-arthopathia hypertrophiante" in man. Ball and Alamartine<sup>54</sup> had observed a tubercular dog which had the same macroscopic and microscopic processes as those seen by Lienaux, and therefore it suggested itself to Lienaux<sup>55</sup> that the term "osteoarthropathy" would be better than "diffuse osteo-periostitis" or "ostitis deformans"

The few cases described by Kitt and Lienaux show great analogies with my case. The processes, however, are not as far advanced in either case, and there are also differences in the ages of the dogs affected. The animal seen by Kitt was one year old, those reported on by Liénaux were all over ten years old when first seen. Aside from these minor differences, which also occur frequently in human patients, the cases are identical with mine so far as concerns the anatomical lesions of the bone system.

In none of these cases a satisfactory clinical or causal explanation has been given, the tuberculosis in Ball and Alamartine's case was an accidental complication, and they all belong most probably to and should be classified as myositis ossificans progressiva of the dog

In order to arrive at a better understanding of the basic features of our malady, it appears advisable to me, before we enter into a discussion of the peculiar and specific characteristics of the progressive ossifying myositis, that we should now consider collectively all those traits it possesses in common with its near relative, the traumatic myositis ossificans and its experimental imitation. They all center around the pathologic anatomical structural pictures and bone-forming process, they are identical in appearance and modes of procedure in both affections.

In fixing its place among the pathological entities it occurs at once that Virchow's view of its being a multiple exostosis must be abandoned in spite of the master's word, and the free growth conceded within the confines of the muscle and its surrounding connective tissue

We have the research work of many authors, including our own case, to establish the evidence of independent growth of bone tissue within the muscle bundles and their connective-tissue envelopings and dividing partitions

That question also as to the primary point of attack, still indicated by the name myositis, may be considered settled. Every observer who has excised a piece of the affected tissue at an early stage of the local pathological change has found the inter- and intramuscular connective tissue to be the primary

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<sup>&</sup>lt;sup>53</sup> Alamartine Osteo-arthropathies hypertrophiantes d'origine tuberculeuse Revue de chirurgie 35, 1907, p 992

<sup>&</sup>lt;sup>54</sup> Ball & Alamartine Pathologie & Osteo-arthropathie hypertrophiante d'origine tuberculeuse chez l'homme et chez le chien Revue de chirurgie, 1908

<sup>&</sup>lt;sup>55</sup> Lienaux Remarque au sujet de la nature de l'ostéo-arthropathie hypertrophiante Bull de l'Academie Royale de Medecine de Belgique 27 fevrier, 1909

seat of attack, even before my discovery of isolated bone-tissue in the skin removed the possibility of doubt. In both diseases the muscle fibres are the secondary sufferers and succumb only to the increasing pressure and embodying force of the growing ossification. While these two questions are easily absolved, we encounter a greater difficulty in order to arrive at a satisfactory result in establishing the manner and the identity of the bone-forming process.

Although the oldest attempt to explain the heterotopic ossification by a metabolic retention of lime has been refuted by the exact modern investigations of both Burgerhout<sup>50</sup> and Austin<sup>57</sup>, the fact that its presence as a local deposit is an essential condition for bone-formation continues to be valid The truth of this assertion has been proven by the experimental work of Dibbelt<sup>58</sup> through calcium supply by way of the alimentary canal, and by hypodermic injection of 1 per cent solution of chloride of calcium of Koga<sup>59</sup>. this latter successfully repeated by Goto Goto Many other authors confirm it by their observations on humans and point at the initial hemorrhage as the source of the calcium supply in spite of its rather low percentage in the blood The idea of looking to the blood as the first cause of ossification, either as a direct irritant for its initiative stages or as a chemical one through its lime deposit, hes very close if one considers that in cases of traumatic ossifying myositis the first effect of the trauma is always a hemorrhage into the injured tissues

We may dispense in these cases with a serious consideration of the periosteal participation, as only the entirely severed and intramuscularly implanted periosteum gives rise to a free bone-formation, whilst the flap always shows the new-formed bone in connection with the underlying skeletal bone, and it would be more than unreasonable to presume that the great majority of traumatisms responsible for a case of skeletal-free myositis ossificans tear off a piece of periosteum and transplant it into the adjoining muscular tissue.

Many clinicians, as we have seen, were able to witness the growth of the newly-formed bone directly from the initial hemorrhage to the final extirpation of the finished product. The well-known Schede blood-clot for the filling of bone cavities has often served its purpose and the microscopical pictures of early stages of traumatic as well as progressive cases show so constantly the more or less well-preserved remnants of an infiltrating blood-extravasation close to or surrounding the various stages of ossification, from earliest connective-tissue hypertrophy and calcification to complete ossification, that the causative connection becomes irresistibly impressive. Such an impression, gradually rising to a firm conviction, I have also

<sup>&</sup>lt;sup>80</sup> Op cit

er Op cit

<sup>59</sup> Op cit

<sup>80</sup> Op cit

<sup>&</sup>lt;sup>∞</sup>Op cit

gained from the study of my slides, and in their description and illustration I have tried to convey this conviction to my readers. The various anatomical regions show the progress of bone-formation on different paths, osteoblasts with a fibrous or cellular cartilaginous route in the intra- and intermuscular connective tissue to direct calcification and osseous growth in the hypertrophic fibrous connective tissue of the skin, all starting from the primary blood clot. But with even the fullest admission of the blood's causative ossifying action, we have moved but one step farther toward the solution of the mysterious problem. The question arises now, what are the determining conditions to induce in some cases an ossification 'after a subcutaneous tissue-invading hemorrhage, and in the vast majority of other similar traumatic cases simply an uninteresting and uninterrupted absorption?

In the description of my microscopical pictures I drew attention to a tissue zone surrounding a developing ossifying part, which zone refused to take the stain well, and with its peculiarly indistinct cell and tissue differentiation showed the unmistakable picture of tissue-necrosis

A similar area, although not specially mentioned as such, may be seen in Goto's microphotographs of his experimental myositis ossificans produced by means of the chloride of calcium injections

This tissue-necrosis, following the initial hemorrhage, we believe to be another determining factor for the comparatively extremely rare sequel of ossification to muscular traumatism. This tissue-necrosis, as a preliminary condition to calcification and later ossification, is mentioned by Rohmer<sup>61</sup> in his description of bone-formation in focal endocarditic and endarteritic calcareous necrotic ulceration, of which latter Moenckeberg<sup>62</sup> met with ten in 100 cases of senile arteriosclerosis. Pollak<sup>63</sup> found that the ossification took place in all his cases around calcified necrotic foci in the lungs, and let us recall here that local calcifications of necrotic caseous foci are not infrequently seen in old ulcerative pulmonary processes

Sacerdotti and Frattin<sup>64</sup> produced ossification in secondary necrotic foci of the kidneys, the blood-vessels of which they had ligated, and thereby caused primary hemorrhages Liek<sup>65</sup> obtained identical results

J F Poscharissky<sup>66</sup> examined heteroplastic osteogenesis in lungs, heart, blood-vessels, lymphatic glands, brain, eye, uterus, liver, thyroid gland, and always met with regressive metamorphosis (necrotic foci) as the primary incentive for calcification which was followed by ossification. He found that there exists a kind of an antagonism between the necrotic centre and the living periphery of the affected tissue nodule, which is being demonstrated by an effort of the connective tissue to enter into the necrotic centre.

<sup>61</sup> Op citat

<sup>&</sup>lt;sup>e2</sup> Ueber Knochenbildgn in d Arterienwand Virch Arch, Bd 167, 1902

<sup>63</sup> Op citat

<sup>64</sup> Op citat.

<sup>&</sup>lt;sup>65</sup> Experimenteller Beitrag z Frage d heterogenen Knochenbld Arch f kl Chirurg, Bd 80, p 279

es Beitraege (Ziegler's) z pathol Anat & allgem Pathologie, Bd xxxviii, p 135

shows a constant tendency to grow He concludes that osteogenesis may occur in any organ of the human body if there exists a necrosis of the tissue, or at least a sclerosis so intense that it is interfering with the natural blood supply and accompanied by an incrustation with calcium salts. In all his observations Poscharissky never encountered the formation of cartilaginous tissue.

A Barth shows, in his experiments <sup>67</sup> on bone implantation, new growth of bone only took place after a soil of dead tissue had been provided for it and that <sup>68</sup> calcium favors rapid ossification

S Ehrlich<sup>60</sup> holds that the 1ron when available (from hemorrhages) serves as a mordant for the calcium which is subsequently deposited

H Gideon Wells<sup>70</sup> finds as a result of his own and others' experiments that calcification, as the preliminary stage of pathologic ossification, takes place only in dead (necrotic) tissue or in such of low vitality and insufficient circulation. Physiologically, calcification in old age takes place also in ill-nourished tissue, like the laryngeal or costal cartilages.

He gives the amount of calcium contained in blood (serum) of mammals as from 0 i i to 0 i 3 i per cent, 71 about two to four times as much as is soluble in water

It may be seen that his conclusion is well supported by pathologic-anatomical evidence. The decision which of the two, the hemorrhage as calcium supplier, or the necrosis as the stimulating and receptive soil for calcification, is the more important for the final ossification, seems impossible to decide at present

Goto's<sup>72</sup> experiments on rabbits and guinea pigs, in producing intramuscular hemorrhages by severe hammering of the quadriceps femoris never resulted in ossification, the very early excision after the traumatism showed calcifications of the torn muscular fibres amid the fresh hemorrhages, later excisions showed complete resorption of the hemorrhage and the destroyed tissue, in their stead simply a replacing connective-tissue hypertrophy. By the daily injections of 3 cm of 1º per cent chloride of lime solution into the quadriceps, continued for thirty consecutive days, bone-formation could be produced. A shorter period, however (eight days), only showed conditions similar to the early traumatic pictures. An unbiased interpretation of these experiments still leaves open the question of the more important factor, lime or necrosis. The lime supply alone by blood extravasation does not seem sufficient to induce the entire range leading to ossification if a reparative

<sup>&</sup>lt;sup>67</sup> Beitraege (Ziegler's) z pathol Anatomie & allgem Pathol 1895, Bd xvii, p 65 <sup>63</sup> Ueber kstl Erzeugg v Knochgew & ueber d Ziele d Osteoplastik Berl kl W, 896, p 8

<sup>&</sup>lt;sup>60</sup> Eisen & Kalkimpregnation in menschlichen Geweben Centralbl f allg Pathologie, 1906, xvii p 177

<sup>&</sup>lt;sup>10</sup> Calcification and Ossification Archives of Internal Medicine, vol vii, June, 1911, No 6, p 721

<sup>&</sup>quot;Op cit

<sup>&</sup>quot;Op cit

process intervenes and resorption interrupts the progressive stages, is this reparation, however, prevented by a long continuance of lighter daily traumatisms assisted by the constant addition of calcium supply, both carried on by the intramuscular injections of comparatively large quantities of calcium chloride solution, then bone formation is induced

The foregoing explanatory attempt, although valid for both the progressive as well as the traumatic ossifying myositis, only speaks for both after the occurrence of the initial hemorrhage

While the cause of this extravasation needs no further explanation in the traumatic form of myositis ossificans, a hemorihage as forerunner to ossification in the progressive form seems as inexplicable as its constant association with microdactylia as a characteristic symptom

We have tried to lay the hemorrhage to a deficiency in coagulability of the patient's blood, but the tests we made did not bear us out, coagulation occurred even ahead of the normal time, and the reason for the precursory hemorrhage in myositis progressiva ossificans was not explained by any failure of proper coagulation

It seems, moreover, apparent that all the strange characteristics of this disease are more or less interdependent and might be treated as due to a common cause. It may be possible to advance our understanding of these connective features by examining the progressive ossifying myositis in comparison with other maladies that offer certain symptoms common to both

The feature of heredity in this disease has hitherto been treated as negligible, as in all formen compilations only one case (No 70, Faughan and Fanning) of hereditary transmission of disease and deformity had been ascertained. We have found two more instances, one (No 30) and (No 81) a case of Gaster, going through three successive generations, grandfather, father and three sons, with a selective preference for the male members of the families, who, besides being victims of the ossifications, showed, every one of them, the marked congenital finger and toe deformities

This deformity, brachydactylia, occurring independently, has engaged the attention of many writers and aroused great interest on account of certain embryological phylogenetic questions. Brachydactylia may be due to either the shortness of a metacarpal or metatarsal bone, or of one or more phalanges, or of either combined, and it may be appropriate to differentiate them by calling the first brachydactylia, the second brachyphalangia and the third brachydactylphalangia or brachyphalangodactylia

The two views, as to the causes entering into the production of carpal deformities, are the exogenetic, mechanical, and the endogenetic, embryological. The brilliant results of Tornier<sup>73</sup>, in experimentally producing various deformities of hyperdactylia in tritons and other animals possessing similar regenerative force, lent great support to the mechanical explanation

<sup>&</sup>lt;sup>13</sup> Ueber Hyperdaktylie Regeneration & Vererbung mit Experimenten Arch f Entwicklgsmchk d Organismen Bd 111, 1896, p 409

of such deformities as hyper- and hypodactylia, syndactylia, etc., through the agency of amniotic bands and intia-uterine pressure

Even for brachydactylia a similar explanation was advanced upon the theory of localized pressure from projections of uterine walls, although a clear conception how such pressure could act in the human as to influence the growth of a single metacarpal bone has never been given. Far less possible appears such a solution for symmetrical brachydactylia of one or more metacarpal bones, and we shall try and briefly give our reasons for rejecting this theory for brachydactylia, with which myositis ossificans progressiva is preeminently associated, and for claiming for this deformity an endogenetic cause

We know that the "anlage" of the carpus consists of three parallel tissue rays (gewebstralen) which divide again in several parts of which the radial (or relatively tibial) and medial continue into the first two fingers (toes) and of the ulnar (fibular) ray which traces its origin secondarily from the ulna (fibula), issuing lateral branches from the fourth and fifth fingers, also for the basal elements of the third finger. Thus we see at first the "anlage" of first and second fingers, later of the third and last of the fourth and fifth. We find a certain relationship in the extent of deformities according to this normal mode of development

The following references are only an approximately complete list of the literature of this deformity, and in order not to devote too much space to this section of my paper, the cases will be but briefly quoted

M Leboucq\*\* mentions a case of bilateral symmetrical brachydactylia of all the fingers

E W Roughton<sup>73</sup> demonstrated a case of brachydactylia of the right big toe in a 30-year-old man, and of the fourth toe on left foot. In the second case the brachydactylia affected the third, fourth and fifth toes of both feet

Julius Sternberg $^{76}$  registered two cases, the first showed brachydactylia of both third fingers and both third toes, the second brachydactylia of both fifth toes

E E Goldman<sup>17</sup> describes a case of brachydactylia of the third, fourth and fifth fingers of the right hand, and of the fourth and fifth fingers only on the left hand. The same patient showed symmetrical brachydactylia of both fourth and fifth toes

L Freund<sup>78</sup> reports a brachydactylia of both fourth fingers of a young man The distal epiphyses were shortened and atrophied

Rieder mentions a man with an interesting case of combined brachydactylia of

<sup>&</sup>quot;Brachydactylie et Hyperphalangie symetrique de l'Index et du Medicus Bulletin de l'academie Royale de Medecine de Belgique Tome x, No 5, 1896, p 345 (This case had been presented already to the Med Soci of Ghent by Dr M Colson in 1883 and published in Pfitzner's essay on this subject)

<sup>1897</sup> Lancet, July 3, 1897

<sup>&</sup>lt;sup>76</sup> Symmetrische Verkuerzg d 3t Mittelhdknoch Wiener klin Wschrft 1902, No 41, p 1060

<sup>&</sup>quot;Beitrag z Lehr v d Missbldgn d Extrm Beitraege z klin Chir, Bd vii, 1891, p 239

<sup>&</sup>lt;sup>18</sup> Die Brachydaktylie durch Metakarpalverkuerzung Ztchrf F Heilkde 1906, Abth f Chir etc Bd xxvii, p 129

<sup>&</sup>lt;sup>9</sup> Ueber gleichzeitiges Vorkommen von Brachy- und Hyperphalangie a d Hand Deutsch Arch f klin Med, Bd 66, 1899, p 330

the fourth finger of the right hand and hyperphalangia (three phalanges) of the thumb of the same hand. The daughter of this man had syndactylia of the right hand and hypophalangia of all other extremities

Wagner<sup>80</sup> published the case of a woman who showed a bilateral brachydactylia of the third and a unilateral of the fourth fingers

Hochheim<sup>81</sup> adds the case of a woman 18 years old with a bilateral brachydactylia of the third, fourth and fifth fingers and a brachydactylia of third and fourth toes, with shortened distal epiphysis and an imperfect development in breadth. A brother had a brachydactylia of the fourth right toe

G Joachimsthal<sup>52</sup> communicates two cases from his experience. He observed a woman of 27 years with a bilateral brachydactylia of the fourth and fifth and a brachyphalangia of the second and third fingers, and two women of 29 and 22 years, sisters of the former, with the same deformities, although not quite so pronounced. The only brother is normal, but has a daughter i year old with the same defects, and a son of the older sister had the identical deformities. In the same article were the very interesting cases of a young man with a bilateral brachyphalangia (middle phalanx) of the second and fifth fingers, whose mother was equally afflicted, a case of a girl 12 years old with a bilateral brachydactylia of the fifth finger, and of two women, 25 and 31 years old, each with bilateral brachydactylia of the fourth fingers

From Cerechellis Institute, Carlo Fossetti<sup>58</sup> reports an observation of a bilateral brachydactylia of the fourth finger in a woman of 28 years. The distal epiphyses of the fourth metacarpals were shortened and atrophied.

Alfred Machol<sup>84</sup> describes the following cases from the Breslau clinic Girl 17 years, brachydactylphalangia of the third finger of left hand Besides a shortening of the third metacarpal bone, there existed also one of the basal phalanx The distal epiphyses of the third metacarpal and the proximal one of the basal phalanx are rarefied and atrophied and demonstrate the cause of the deformity

Woman of 34 years, shows a symmetrical brachydactylia of the fourth fingers and brachydactylia of the right fourth toe. The distal epiphysis of the fourth metacarpus is round like a ball and sits squarely on the diaphysis. The osseous structures of both metacarpal phalanges are rarefied.

A girl of 30 years with a unilateral brachydactylia of the fourth left toe In this case also the osseous substance of the deformed toe is rarefied

A girl of 12 years had scarlatina when two years old, followed by a paresis and debility of the entire right leg. Circumference over entire leg about 2 cm less than the correspondingly right side. Brachydactylia of fourth toe of same side, osseous substance atrophied. Also smallness and atrophic state of phalangeal epiphysis, which may, however, be attributed to the generally impaired nutrition of that leg.

Boy 12 years old, poliomyelitis anterior when three years old Pes varus sinister Left foot slightly smaller than right Brachydactylia of the fourth left toe The osseous substance of left fourth metatarsus atrophic and bone-tissue rarefied Distal epiphyses likewise compressed and squatty

<sup>&</sup>lt;sup>50</sup> Beitrag zur Kenntniss der Brachydactylie Fortschi a d Geb d Roentgensc 1903, Bd vii, pp 94-98

<sup>&</sup>lt;sup>81</sup> Fall von Brachydaktylie Fortschr a d Geb d Roentgenstralen, 1904, Bd vii, S 273-76

bet 2 d Fortschritte auf dem Geb d Roentgenstralen Hamburg, 1900

sa Brachidattilia simmetrica della mano. La clinica chirurgica 1914, No. 11, p. 239

<sup>\*</sup> Mitteilungen a d Grenzgebieten d Medizin & Chir (Mikulicz Gedenkband) Jena, 1907, p 712

Faulhaben<sup>15</sup> observed in a patient 22 years old symmetrical bilateral brachydactylia of the fourth and fifth fingers

Fontana and Vachelli<sup>50</sup> encountered a most interesting triplicate of cases concerning two sisters, 16 and 12 years old, each with bilateral brachydactylia of the fourth fingers, and their mother, who showed this deformity on the left side only Another woman, who did not belong to this family, also had a brachydactylia of the left fourth finger

Lunghetti<sup>st</sup> relates the case of a man 32 years old with brachydactylia of both third fingers and brachyphalangia of the middle phalanx of the fifth fingers

Kenyeres saw a man of 37 years with symmetrical brachydactylia of the fourth fingers. The terminal phalanx of the left thumb was also about one-third shorter than that of the other side

A Mosenthal<sup>59</sup> describes (1) a brachydactylia of a young girl 20 years old affecting the fourth and fifth metacarpals of both hands (mother said to have had the same deformity), and showing a marked atrophy of these bones (2) The cases of mother and daughter both with bilateral brachydactylia of the first metatarsus, with abduction of big toe (hallux varus)

Erich Ebsten<sup>60</sup> communicates in the same article an observation of brachydactylia of the left ring-finger and another case of a brachyphalangia of all four fingers of the left hand caused by the shortening of the middle phalanges only

Similar cases of familiary heredity deformities of the fingers since the observation with the X-ray are but few, Julius Drey<sup>61</sup> had occasion to observe four generations of a family, the various members of which (thirteen normal, twelve defective) suffered from hypophalangia and digital synostosis

Rich Pott<sup>92</sup> enjoyed a similar opportunity of observing in pre-X-ray times unmistakably hereditary defects in four successive generations. The members of this family, of which nine were normal, showed in five oblique nail phalanges of thumbs, three double end phalanges and three double entire thumbs (six complete fingers on each hand)

H Drinkwater<sup>62</sup> reports two cases of hereditary transmission of digital deformities, members of both familes suffering from brachyphalangia. The deformity was caused in both families from an absence of the second phalangeal epiphysis, at the base only in one family, who showed in four generations twenty-six normal and twenty-one short-fingered members, the other in as many generations, with both epiphyses defective, had ten normal and nine short-fingered ones. This latter family was peculiarly interesting, as one of its normal married women had practiced illicit intercourse with a short-fingered man. She gave birth to one short-fingered son, who

E Deutsche mediz Wochenschr 1904, p 1454

<sup>&</sup>lt;sup>50</sup> Archiv d Ortoped 1902

<sup>&</sup>lt;sup>87</sup> Sopre un caso brachydattilia simmetrica della mano Archivio di Ortopedia Febr 1902, p 52

ss Fortschrite and Geb d Roentgenstralen Bd 1x, 1905-6, p 351

<sup>&</sup>lt;sup>89</sup> Eleventh German Orthopædic Cong Einige Faelle v Brachydactylie Verholgn d deutsch Ges f orthop Chir 10th Congr 1911, p 36

<sup>&</sup>lt;sup>10</sup> Zur Aetiologie d Brachydaktylie Mitthelign a d Grenzgebieten d Mediz und Chir Bd 21, 1910, p 531

<sup>&</sup>lt;sup>81</sup> Hereditaere Brachydaktylie kombinirt mit Ankylose einzelner Fingergelenke Festschrift gewidmet M Kassowitz, p 34, Berl, Julius Springen

<sup>&</sup>lt;sup>12</sup> Ein Beitrag z d symmetr Missbildgn d Finger & Zehen Jhrbch f Kinderhlkde, Bd xxi

<sup>&</sup>lt;sup>95</sup> Account of Family showing Minor Brachydactylia Journal of Genetics, vol 11, p 21, 1912-13, p 21

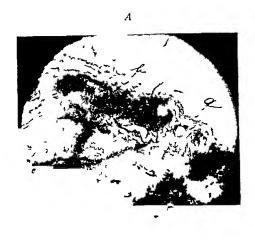
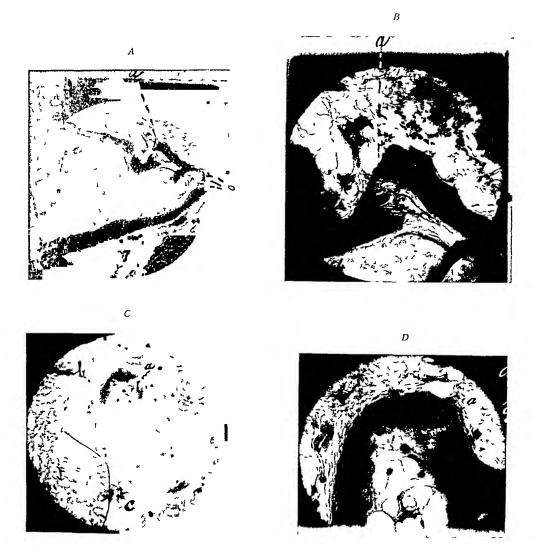




Fig. 35—A, Connective-tissue bridge and predominant participation of erythrocyte in bone formation a, connective tissue bridge, b erythrocytes participating preeminently on ring in bone formation (oc 2 ob) 8) B Connective-tissue bridge and predominant apparent erythrocyte participation in formation of ring (enlargement of Fig. 4) a erythrocytes, a', erythrocytes in apparent participation of formation of ring, b ring, c connective-tissue bridge



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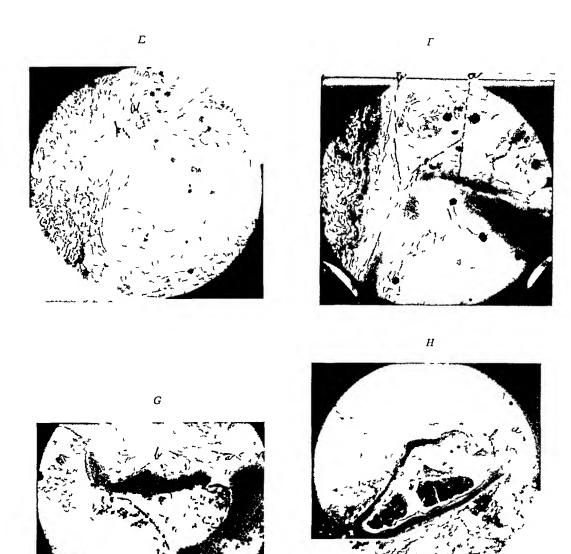


Fig 36—Connective-tissue bridge with projection inside A a connective tissue bridge, b connective tissue projection inside ring (oc 2 obj 16) B a connective tissue bridge, b connective-tissue projection inside ring (oc 2 obj 4) C a connective tissue projection toward inside of ring and bridge b connective-tissue participation in bone formation c suderiferous gland (oc 2 obj 16) D a, connective-tissue projection toward inside of ring and bridge, b connective tissue participation (oc 2 obj 4) C a connective tissue bridge, b connective tissue participation in bone formation outside of ring (oc 2 obj 4) C a connective-tissue bridge, b connective-tissue participation in bone formation outside of ring (oc 2 obj 4) C a connective tissue bridge b erythrocyte participation (oc 2 obj 16) C a connective tissue bridge C and C and C are connective tissue bridge C and C are connective tissue bridg

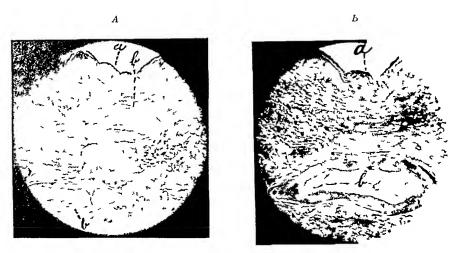


Fig. 37—Bone rings with empty centre near epidermis. A a epidermis, b emptied bone ring (oc 2 obj a a epidermis, a emptied bone ring (oc 2 obj a a epidermis, a emptied bone ring (oc 2 obj a a a epidermis, a emptied bone ring (oc 2 obj a a)

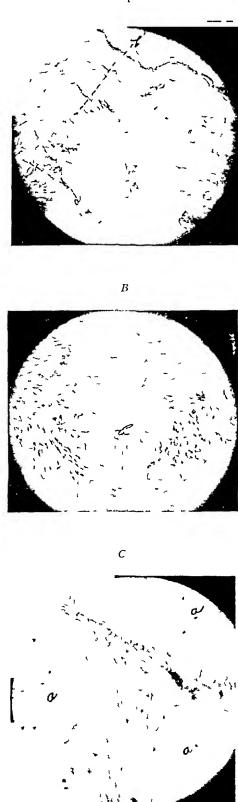


Fig. 38—Initial hemorrhage at the side of three solidified bone formations all close to epidermis A a two of the bone formations b hemorrhage (oc. 2 obj. 2\*) B b hemorrhage (oc. 6 obj. 16) C a the three bone formations in part (oc. 6 obj. 16)

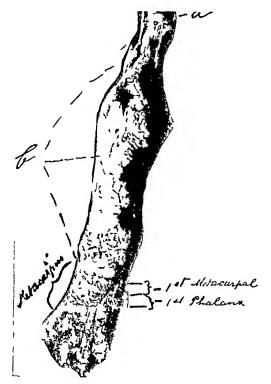


Fig. 30—Right thoracio extremity of dog (unterior view) a head of humerus in glenoida fossa b ossifications—compare diminutive first metacarpal and first phalanx of thumb with those of other digits

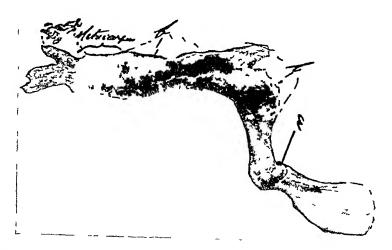


Fig. 40—Right thoracic extremity of dog (posterior view) a head of humerus in glenoid fussa b mass of ossification c location of thumb anteriorly



Fig. 41 —Longitudinal section through right wrist and carpal bones

in his turn was the ancestor of all the other short-fingered progeny, so that in this family the hereditary defect was limited to the side-issue of the hired man

Philip W Mathews<sup>94</sup> had the extremely rare opportunity to observe a hereditary true brachydactylia through five generations. All the afflicted members had shortening of the third, fourth and fifth fingers on both hands, with broadening of the third phalanx of both fourth fingers.

Mario Bertolotti<sup>95</sup> gives another very remarkable report of three generations of a brachydactylic family, with ten out of a total of fifteen members showing a brachydactylia of the third fingers, he enters into the developmental history of the metacarpal bones and refers to Meckel, who came to the conclusion that the first metacarpal, judging by its location and peculiar service, and especially owing to its mode of ossification (being the only one of the metacarpal bones which has its epiphysial nucleus like all the phalanges on the proximal side), should be considered the first phalanx of the thumb Radiography shows that at times one encounters in boys from 5 to 15 years an accessory nucleus on the distal side besides the old classical proximal

Ludwig Freund<sup>66</sup> published the first of such cases and showed that in about 24 to 30 per cent an additional distal special epiphysiary nucleus to the usual proximal one in the first metacarpal (also the first metatarsal in myositis ossificans progressiva) may be seen. He also found an occasional extra proximal nucleus in the second and fifth (in our case in the fourth) and that the atrophic character of such nucleus formation shows a regressive anatomical variation

According to Dubreuil-Chambardel<sup>97</sup> this ossifying nucleus in a distal epiphysis of the first metacarpal was present in eighty-two cases out of a total of 240 X-ray examinations. It commenced to appear in the third year and the complete ossification was reached at about the thirteenth or fourteenth year.

Freund<sup>98</sup> has observed the accessory variation now and then on the proximal side of the second, and, even more rarely, of the fifth metacarpal bone. These men all believe that the choice of epiphysial nuclei of the metacarpal bones depends upon their separate physiological functions. Therefore the proximal site in the first metacarpal depends upon the adaptation of this metapodical process to the functions of the thumb. To support this hypothesis Bailleul<sup>90</sup> as well as Dubreuil-Chambardel have each published a radiograph of a case of a triphalangeal thumb, where the first metacarpal showed its nucleus of ossification only on the distal side

According to Koehler<sup>100</sup>, however, this anomaly represents a certain regressive type met with in the cetaceæ and other water-mammals, where the thumb and big toe have two epiphysial ossifying nuclei. He also quotes Henle as having demonstrated from comparative anatomy that the metacarpal bones had originally two nuclear epiphyses at the same stage of development, a proximal and distal one, although with the human the rule is the distal one for the four last and the proximal one for the first metacarpal. Cruveilhier and Gegenbaur hold the same opinion. They draw attention to the curious anatomical conformation of certain

<sup>&</sup>lt;sup>94</sup> A Case of Hereditary Brachydactylia Brit Med Journ, Oct 31, 1908, p 969

<sup>&</sup>lt;sup>55</sup> Contributi radiolog allo studio della sciluppo osteogenetico dei metacarpei La Radiologia medica Marzo, 1915, vol 11, Fasc 3, p 105

<sup>&</sup>lt;sup>96</sup> Ueber Pseudoepiphysen Ztschrft f Morphologie & Anthropologie, vol viii, 1905, p 87

<sup>&</sup>lt;sup>97</sup> Sur le development du premier rayon digital, Gazette medicale du Centre, p. 288, 1913

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Ossification du 1r metacarpein Societe de Biologie March, 1911

<sup>&</sup>lt;sup>100</sup> Vollzaehlige proximale metakarpale Epipliysen Fortschr a d Geb der Roentgenst, vol xix, p 279, 1912-13

cetaceæ, balaenidæ and sureniæ, who present double epiphyses of the four last metacarpal and an evident trace of an additional distal epiphysis in the first

Freund<sup>101</sup> confirmed these statements by his own investigations of various cetaceæ A double epipyhsial nucleus in human metacarpals appears, therefore, in the light of a reversive type or mongolism

Koehler<sup>102</sup>, who advocates this view, supports it with the report of a unique case in medical literature. A patient 12 years old, suffering from infantile myxædema, showed, in the X-ray picture of his hand, a development of his carpal bones corresponding to that of a child of three to four years, and all the epiphysial nuclei of his five metacarpal bones were on the proximal side

Bertolotti supplements this with a radiographic discovery in the course of examination of his above-mentioned family. He found the brachydactylic members showing pseudo-epiphysial basal nuclei of their second metacarpal bones

We cannot close this discussion of functional adaptation of nuclei of ossification with regard to the first metacarpal bone without adding here an observation pointing apparently to the opposite direction. W Riedei 103 published the case of a family of eight persons in its third generation, showing bilateral hyperphalangia of thumbs (first metacarpal and three phalanges). They were father, 45 years old, daughter, 19 years old (first marriage), and her two daughters, 12 and 11 years, also her son, 4 years old, all three from her second marriage.

This array of facts refutes, we believe, conclusively any attempt to explain the presence of brachydactylia from exogenic causes, either by amniotic bands or intra-uterine pressure. The overwhelming evidence of the hitherto unused material of myositis ossificans progressiva, showing in practically every true case the accompanying feature of symmetrical brachydactylia of fingers, toes or both, does not seem necessary to prove that defects in the primary "anlage" must be held responsible for this deformity, a view which Burgerhout<sup>104</sup> expresses very strongly in his dissertation

We cannot enter here into the more subtle questions of mongolism or atavism, which present many tempting reasons for discussion, but stand firmly for the adoption of primary endogenic developmental causes for brachydactylia. To this extent we may expect now to clear the way for a possible later answer to the ever-open question for final causes. Even to the location for the embryonic layer which had been charged with the formative fault—our case furnishes a new aspect. Rolleston to a well as Morley, Fletcher and others are united in singling out the mesoblast as the culprit, Rolleston calling it the skeletal layer with its subdivision of the muscular My case shows bone-formation also in the skin and draws for the first time this outer layer into participation of the pathological process. As our present

<sup>201</sup> Op cit

<sup>103</sup> Op cit

<sup>&</sup>lt;sup>103</sup> Eine Familie mit dreigliedrigen Daumen Zeitschr f Morphologie und Anthropologie 1900, p 177

<sup>104</sup> Op cit.

<sup>10</sup> Op cit

<sup>100</sup> Op cit

views do not sanction the strict division of embryological layers as the exclusive formative agents of distinct types of tissue, it may perhaps be surmised that the pathogenetic cause exerts its influence at a very early period of embryonic life, before any distinct differentiation has begun

We believe a similar origin may be claimed for the osteogenetic hemorrhages. In my series of microscopical pictures a gradual progression is shown from the primary hemorrhage into the corium to the osseous growth by either the fibrocellular or hyaline cartilaginous or the osteoblastic route to the final development into bone tissue. So clear is this progress that in some places the pictures appear to indicate a direct metamorphosis of the erythrocytes into the fusiform osteogenetic cells (fibroblasts). The entire course of events from primary hemorrhage to finished bone lies illustrated before our eyes, but we want to know the reason for these small hemorrhages and here we have to recur to the endogenetic fault in the "anlage" and have it extended to the capillary and minor peripheral blood-vessels

The same developmental disturbances may, on account of the identity or close proximity of the basic tissue for both, easily affect the vascular together with the skeletal systems The fingers or toes present, as endings of the skeletal system, anatomically similar relations, as the smallest bloodvessels and capillaries, as the last endings of the vascular system, in the integumental parts A defective wall-construction of these two may account for a considerably lessened resistance in the integumental tissue, skin and muscular, to slightest traumatism, or variation of blood-pressure, and a consequential easy rupture with resultant circumscribed hemorrhages Thus an acceptance of the theory of a simultaneous "anlage-defect" in the vascular as well as in the skeletal system may give us a better understanding for the causes underlying the early stages of the bone-forming process in this disease, which our microscopic sections so fully illustrate We shall not go any farther in our explanatory attempts and refuse to go "a'sailing upon unknown seas" with Maunz<sup>107</sup>, who, endeavoring to explain his views of formation of bone, asserts that with the anlage of the muscular system and the osseous skeleton, embryonic osteoblastic tissue-germs have been wandering about and deposited in such places of the muscular connective tissue, tendons and fasciæ, where later the osseous formations start shall we enter into a discussion with the other theorists, such as Goeschen<sup>108</sup>. who, after referring to the peculiar calcium metabolism (?) of the myositis ossificans patients as stimulating the ossifying process, finally adds to date the acceptance of a disposition to such ossification cannot be entirely dispensed with" While we have offered a tentative explanation of the pathological anatomical development in line with the microscopical pictures, we must admit our complete ignorance of its more remote causes

The therapeutic part of our theme is very brief 
In the early period

<sup>107</sup> Op cit

Ueber Histologie & Pathogenese der circumscripten Muskelverknoechrg (Jena 1913 Gustav Fischer)

of its history, the disease was attacked with all sorts of remedies, alteratives, solvents for calcium supposedly retained in the system by faulty metabolism, the inevitable iodide of potassium, etc., every one of them with more or less marked success observed solely by its original author but pronounced a complete failure by every other follower The favorable result of thiosinamine injections reported by Boseck<sup>109</sup> has never been achieved by anyone else. moreover, his alleged case of myositis ossificans progressiva lacks every convincing feature of deserving such classification. In myositis ossificans traumatica Aizner<sup>110</sup>, Nicolai<sup>111</sup> and Grosskurth<sup>112</sup> have reported favorable action of the same drug (fibrolysin) This disease, however, disappeared often spontaneously, so the therapeutic effect should not be unreservedly Lately Nové-Josserand and Rene Horand<sup>113</sup> have earnestly recommended an X-ray treatment for the progressive form They report excellent results in their case by a series of twenty-six treatments, all below five Holzknecht I had the abdomen of my case treated in this way without the least effect, except perhaps to stimulate new growths

In summing up, the conclusions of this treatise are as follows

#### CONCLUSIONS

- I Myositis ossificans progressiva is a misnomer for a pathological process of atopic ossification starting primarily in the connective tissue of the exoskeleton and involves in its further progress the tissues of the endoskeleton. It would better be named fibrocellulitis ossificans progressiva. The disease nearly always commences at an early period of life and shows as additional characteristic symptoms a microdactylia of fingers and toes, and in some cases a more or less pronounced degree of infantilism
- 2 Similar to the primary hemorrhage of the traumatic myositis ossificans, the introductory feature of the pathological process in the progressive form is an initial intercellular capillary hemorrhage which starts the growth of newly-formed connective tissue surrounding the hemorrhagic extravasation without any previous hypertrophy of the adjacent connective tissue
- 3 Calcification and ossification take place at first at the newly-formed connective-tissue strands encircling the hemorrhagic mass, and with few exceptions from within outward
- 4 There is an apparent active participation of the enclosed erythrocytes in the bone-formation, they change their round form to a spindle-cell shape and seem to become nucleated as they approach the osteogenetic edge of the encircling ring and merge into its substance
- 5 The microdactylia has an endogenetic origin and is the result of an "anlage" defect of the carpal and tarsal tissue rays ("gewebsstralen"),

<sup>&</sup>lt;sup>109</sup> Zur Heilg der Myositis ossificans progressiva geheilt durch Fibrolysin Muench mediz Wochschr, 1906 p 2350

Muench mediz Wochschr, vol lvi, part I, p 756

<sup>&</sup>lt;sup>211</sup> Deutsche militaeraerztl Zeitschr, Heft 18, 1907

Deutsche militaeraerztl Zeitschr, Heft 18, 1908

<sup>213</sup> Op cit

causing thereby an imperfect development of the last endings of the extremities in one part or other

- 6 The initial hemorrhage is probably due to a similar cause affecting the integrity of the last endings of the vascular system, the capillaries, from where the hemorrhage starts
- 7 The calcification and consequent ossification of the newly-formed connective tissue is due directly and indirectly to the primary hemorrhage. The hemorrhagic effusion with its calcium content starts the first deposit of lime and indirectly stimulates its continuation by a nutritive impairment of the surrounding tissue from pressure of the extravasation
- 8 Investigations made under scientifically correct premises show there is no reason for believing in a diminished calcium excretion or a calcium retention in this disease
- 9 No therapeutic measures against the products or the progress of the disease have proven of any value

An agreeable duty has yet to be discharged My heartiest thanks are due Miss Ophuls and Mrs Hurwitz, the librarians of the Lane and U C Libraries, for their untiling help in providing the literature from their own and the Surgeon General's library, to Doctor Israel, from the latter institution, for the translation of the Slavic papers, and to Mr Ginsburg, the roent-genologist of the Mt Zion Hospital, for his patient and indefatigable photographic work

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# THE DANGERS OF UTERINE CURETTAGE\*

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THE curet, in the shape of a scoop, was first invented and used by Recamier in about 1845 The sharp curet was introduced by J Marion Sims in 1865, and the dull curet by T Gaillard Thomas in 1880 Since its introduction it has been very universally accepted in the surgeon's armamentarium and used with the greatest freedom, the most accepted rule of conduct being "when in doubt curette," more especially as the pathologist offered moral support in the shape of a beautiful classification of the uterine scrapings into glandular and interstitial endometritis, one or other of these conditions being practically always found, or in case it was not very distinctive, it was called a "mixed condition," both elements being present A nice symptomatology was built up around these all the way from amenorrhœa, dysmenorrhœa, metrorrhagia, menorrhagia, or any other kind of a discharge, to general symptoms of lassitude, headache, backache or any other ache almost anywhere In case some women might be missed out, it was stated that it might be present without any symptoms whatever curet and a woman, the old-time gynæcologist would always find endometritis In 1908 Alder and Hitschman 1 demonstrated that what has been classified as endometritis was really nothing more than stages in the usual menstrual cycle, the premenstrual stage corresponding to the old glandular endometritis, and the postmenstrual stage to the old interstitial endometritis, neither of which was pathological Cullen, in the examination of a great many specimens, has demonstrated that endometritis is really a very rare disease It has also been shown that where endometritis really exists hemorrhage is not a symptom<sup>2</sup> Furthermore, uterine hemorrhage is rarely cured by a curettage Busse collected five hundred cases so treated, and only found benefit in 10 per cent Thus we have had to forget all we were taught about endometritis and start over again. But old ideas die hard, and even in some fairly modern textbooks you will still find a good deal about endometritis, while the average practitioner clings to his curet with the fondness of an old friend Were it only ineffectual as a remedial agent not much serious harm would result, but that it is fraught with grave dangers has been long recognized In puerperal infections many deaths have been laid to its door The dangers in this condition have been so emphasized that happily it has now been pretty well abandoned, but it would seem that its dangers in other conditions have not been sufficiently emphasized A P Heineck a collected and analyzed 160 cases of perforation of the uterus occurring during the course of intra-uterine instrumentation, while Schweetzer 4 from 1911 to

<sup>\*</sup> Read before the Alberta Medical Association, Edmonton, September 26, 1918

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1915 was able to find 105 cases reported in the German literature, with a mortality of 25 per cent. I am suie that these figures do not give an accurate estimate of the extent of accidents following the use of this instrument. The successes find their way into the medical literature, the failures are silently buried—sometimes underground. In addition to dangers of rupture, dangers of sepsis and hemorrhage are of considerable importance. In order to get some idea of the difficulties being encountered I sent a circular letter to some of the men practising in this province, and from 24 men received the following 43 unreported cases with 11 deaths—a mortality of about 25 per cent. The names of some of the doctors are omitted by request.

I Cases of Hemorihage —This I believe is a fairly common complication I am reporting five of the more severe cases with three deaths, although I have other case reports, and I am sure nearly everyone has seen cases of severe hemorrhage, which ultimately recovered

Case I —Multipara, aged twenty-eight years, confined two weeks previously by a midwife Had some brownish discharge, a temperature of 101, and a pulse of 120 Some pain and tenderness over the lower abdomen Curetted and some pieces of placenta brought away Hemorrhage became very profuse and uncontrollable, and the patient died soon after being returned to her bed

CASE II — Multipara, aged twenty-eight, two and one-half months pregnant Incomplete abortion, for which a curettage was performed Particles of placenta removed and considerable hemorrhage encountered, but seemed to be controlled Surgeon and anæsthetist had left the patient, when she again began to flow, and died before help could be obtained

CASE III —Primipara, aged twenty-three, pernicious vomiting, for which the patient was curetted. Much hemorrhage was encountered and the patient died six hours later. It is possible that acidosis had some influence in this case, but the attending surgeon is of the opinion that the hemorrhage was the cause of death

Case IV—Reported by Dr E Hobart Reed, Calgary Multipara, aged thirty-five years, very severe hemorrhage following each confinement Incomplete abortion at two and a half months Os found dilated, and in attempting to remove placenta very severe hemorrhage was encountered Uterus had to be packed to save patient's life Eventually she recovered, and at a later date had a resection of the tubes

Case V—Reported by Dr E A Garner, Fernie, B C Miscarriage at four months and was having considerable hemorrhage, curetted by the attending physician, who encountered severe hemorrhage and packed the uterus Five days later she had another very severe hemorrhage, and was curetted without an anæsthetic Condition very low, but she eventually recovered

II Cases of Sepsis—This may be introduced, but more commonly is present, perhaps in a mild form, and is lighted up by the curettage. A curettage in puerperal infections is particularly fatal, and I believe at present

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very rarely done, although I quote one case I have other reports of mild infections following this operation, but only report eight of the most severe, with three deaths

Case VI —Primipara, aged thirty years, difficult labor Rise of temperature on the fourth day with some odor to the discharge Patient anæsthetized and curetted, following which she had a chill and very severe septic symptoms from which she died about ten days later

Case VII —Reported by Dr E S Garner, Fernie, B C Mrs L, three months pregnant, miscarriage two days previously Temperature 100, pulse 130 Curetted by the attending physician, with the removal of a small amount of placental tissue Patient ran a septic temperature for about a week, when an abscess was evacuated from the pouch of Douglas Patient eventually recovered

Case VIII—Multipara, aged thirty-two years, two and one-half months pregnant. Pain and irregular hemorrhage for a week, after which she was curetted, three days later she took a severe pain with a chill and a rise of temperature to 104 and pulse to 130. She continued to run a septic temperature for some days, when about a pint of pus was evacuated from the pouch of Douglas, after which she made a good recovery.

Case IX — Multipara, aged twenty-seven years, normal confinement with a somewhat slow recovery, after gettang about continued to have a bloody discharge Curettage done by the attending physician, at which a moderate amount of blood was lost, and shortly afterwards she had a very severe hemorrhage, became blanched, pulseless, and nearly died A few hours later she had a severe chill, and temperature rose to 104 She continued very ill with a severe septicæmia for several months, but eventually recovered

Case X—Primipara, aged thirty years, three months pregnant, symptoms of an incomplete aboution, with a temperature of 102, curetted and particles of placenta removed Developed a pelvic cellulitis and ran a temperature for several weeks Later she developed a subphrenic abscess, which was opened, and the patient recovered after being ill for four months

Case XI —Multipara, aged thirty years, miscarried at three months Twice curetted by the family doctor—Ran a high temperature and looked very ill—Uterus explored and particles of placenta found to be still present—Streptococci found in the blood—Patient died about a week later

Case XII — Multipara, aged thirty-seven years, badly lacerated cervix, two months pregnant, self-induced abortion—Chill and a temperature of 104, under rest this subsided, but returned later, and the patient was curetted by another doctor—She then developed a typical septicæmia and died in about a week's time

Case XIII —Primipara, aged twenty-four years, normal labor Temperature rose to 104 on the fourth day, light curettage performed, after which she ran a normal temperature for two weeks, temperature then rose to 102, together with severe abdominal pains The abdomen

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was opened and an abscess found in the outer wall of fundus of the uterus, which had ruptured into the peritoneal cavity. This was drained and the patient made a good recovery

III Cases of Rupture —I have collected twenty-seven of these cases, with four deaths Rupture may be of the cervix, the body or the fundus, and may be made by dilators, sound, or curet

Case XIV—Reported by Dr J H Gillespie, Picher Creek, Alta Primipara, aged twenty-six years, with a badly ruptured cervix, where a curettage had been previously performed for sterility. The operation did not produce the desired effect, but instead gave the patient a lot of new trouble. I have other cases where the cervix has been badly lacerated, but the results are usually not serious, and I merely quote this one as an example.

Case XV —Multipara, aged thirty-five years, miscarriage, probably induced, some sepsis present. Curetted with a blunt curet. Uterus perforated and a piece of bowel brought out. This was pushed back and the cavity of the uterus packed with iodoform gauze. Patient recovered in about two weeks.

Case XVI —Multipara, aged thirty-five years, miscarriage Some signs of sepsis present. Curetted with a dull curet. Uterus perforated and a piece of bowel brought out, replaced, and the cavity of the uterus packed with iodoform gauze. Recovered in about four weeks

CASE XVII—Reported by Dr C W Holmes, Edmonton Multipara, aged twenty-six years History of irregular bleeding for three months, miscarriage taking place at the fourth month Large amount of placenta removed with the curet, when with no undue force the uterus was perforated. There was no sign of undue hemorrhage and as conditions were unfavorable for abdominal section, patient was left and no ill result followed.

Case XVIII —Reported by Dr T M Campbell, Lethbridge Multipara, aged forty-four years Not a very robust woman, but not suffering from any organic disease Two months pregnant. Had had a dark bloody discharge for a month. Temperature 99 8. Uterus large, soft and flabby, with a patulous os from which issued a dark foul discharge. Patient was curetted, every aseptic precaution being taken, but inside of a week the patient died of septic peritonitis.

Case XIX—Reported by Dr J E Lovering, Lethbridge, Alta Multipara, aged thirty-three years, two months pregnant Stated that another woman had passed an instrument on her. She was flowing profusely, but no temperature. A curettage was done and a large amount of débris removed. With no undue force the curet suddenly passed into the abdomen. The abdomen was immediately opened and a rupture found on the right side of the fundus, which was repaired Appendix and a right ovarian cyst removed. Gall-stones were found and removed by a separate incision. Patient was in a critical condition for several days, but then made a good recovery. Dr. Lovering is of the opinion that the rupture must have been made during the attempted abortion, as he used very little force in his manipulations.

Case XX—Reported by Dr W S Galbraith, Lethbridge Case that was prepared for an abdominal operation, a curettage being done as a preliminary procedure. At the subsequent operation the rupture was repaired with no ill effect

CASE XXI—Reported by Dr W S Galbraith, Lethbridge Where he operated upon a case 100 miles from home, which proved to be an ectopic, and in which the local doctor had curetted and perforated the uterus There was also a severe infection present, and the patient subsequently died

CASES XXII and XXIII —Dr F W Gershaw, Medicine Hat, reports that in two cases he has perforated the uterus with a curet, but in each case he had planned to do an abdominal operation when the rent was repaired, with no serious after effects

Case XXIV — Dr J S McLeod, Medicine Hat, reports that while an interne in an American hospital and doing his first curettage under the direction of the chief surgeon, in a case where the uterus was sub-involuted and friable, a sharp curet was used with considerable care, and suddenly, without any undue force, the uterus was perforated Abdominal section immediately performed and a rupture found on the anterior wall of the uterus, which was repaired, and the patient made a good recovery

Cases XXV and XXVI —Dr C E Smyth, Medicine Hat, reports that he has seen two instances of rupture of the uterus during curettage. In both instances the abdomen was opened and the rupture repaired, with no resulting ill effects

Case XXVII —Multipara Profuse menstruation and some bleeding between periods Anæsthetized and the sound passed to explore the interior of the uterus, and this with no undue force passed into the abdominal cavity. No further manipulation was carried out, and the patient made a good recovery

Case XXVIII —Multipara, two and one-half months pregnant Flowing for several days. Anæsthetized and os dilated with heavy dilators. Placenta forceps inserted and a piece of bowel brought out. This was pushed back and the abdomen immediately opened and a large rent found in the anterior wall of the uterus. This was repaired and the patient made a good recovery.

Case XXIX —Curettage on a multipara for irregular hemorrhage Large dilator used, and this seemed to enter in a forward direction On investigation it was found that the front wall of the uterus had been ruptured Patient was put to bed, but had extreme pain, vomiting and a rising pulse-rate Abdomen was then opened and a rent in the anterior wall of the uterus repaired Drainage inserted and the patient made a good recovery

CASE XXX —Multipara, a German woman with a large, flabby uterus, perforated by a curet with very slight force. Abdomen immediately opened and the rupture repaired. Patient made a good recovery

Case XXXI —This case was witnessed by the reporter in a foreign clinic, where a professor with an international reputation was demonstrating a special dilator, which goes by his name, when the cervix and

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anterior wall of the uterus was badly ruptured, resulting in a profuse hemorrhage and death of the patient

Case XXXII—Reported by Dr J S Wright, Edmonton Multipara, aged thirty-two years History of five miscarriages Endometritis with purulent discharge Dilated and curetted with a moderately sharp curet and with no undue force Curet seemed to pass to an unusual depth Irrigation instituted and the fluid did not return Again explored and rupture located Abdomen immediately opened and rupture repaired Patient made a good recovery

Case XXXIII —Aged thirty-five years, no living children, but repeated miscarriages Was three months pregnant. Complained of a purulent, blood-stained discharge present for a week. Dilated with difficulty, and a macerated mass removed with the dressing forceps. Uterus foul and soft, so that curet passed through without knowledge. Patient died four hours later, and the post-mortem examination showed a softened uterine wall with a rupture on the right side involving the uterine artery. Syphilitic nodes were found throughout the body

Case XXXIV—Reported by Dr J W Auld, Calgary Multipara, aged thirty-four years Abortion at three months a short time previously Double salpingitis, for which the patient was prepared for operation, preliminary curettage with a sharp curet Without undue force fundus of the uterus was perforated. At the abdominal operation the tubes and uterus were removed, and the patient made a good recovery

Case XXXV—Primipara, dilated and curetted for dysmenorrhoea Sound passed through the anterior wall of the cervix instead of through the internal os, this was followed by dilators, and it was then found that rupture had taken place Packed with iodoform gauze, and the patient made a good recovery

Case XXXVI—Multipara, aged thirty years Not pregnant Irlegular bloody discharge, and the patient thought she was pregnant, and passed an instrument upon herself. A few days later patient was anæsthetized and sound passed without any obstruction. Large dilator inserted into the same passage and dilated. Forceps inserted and a piece of bowel brought out. Abdomen immediately opened and a rupture found in the posterior wall of the uterus. This was repaired and the patient made a good recovery. Surgeon in charge was of the opinion that the rupture must have been made by the woman

Case XXXVII —Multipara, aged thirty-seven years, two months pregnant, had been flowing for a month—Uncertain whether the fœtus and placenta had been expelled—Anæsthetized, and the sound passed This without any undue force perforated the uterus—Packing inserted, and patient made a good recovery

Case XXXVIII—Multipara, aged thirty-three years Two and one-half months pregnant Admitted having passed an instrument some time previously, and was flowing freely Dilated, and pieces of placenta removed When finally exploring with a dressing forceps a piece of bowel was brought out This was returned and the uterus packed The patient made a good recovery The surgeon in charge is strongly

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of the opinion that the rupture must have been made by the woman herself

Case XXXIX —Multipara, aged thirty-eight years History of an abscess with purulent discharge after the second child Miscarried at the second month Os dilated with graduated dilators, and the direction of these did not seem to be correct. An investigation showed that the posterior wall of the cervix had been ruptured and the instruments were passing up into the abdominal cavity. Packing was inserted and the patient made a good recovery.

Case XL —That late results may follow rupture is shown by the report of a case by Dr E W Allin, Edmonton, where intestinal ob-

struction followed an old rupture of the uterus

Many men reported that they were positive the rupture must have been previously produced, as they used so little force, yet I saw some of these cases and they did not suffer from any vomiting or abdominal pain previous to the operation, and the rupture when repaired was recent I am of the opinion that it should rather indicate how easy it is to produce a rupture. The treatment of this condition, when produced should depend upon the circumstances. If the case is clean and the rupture a small one it is better to leave it alone and no ill results will follow. If, on the other hand, the rupture is large, or if there be sepsis, the abdomen should be immediately opened and the condition rectified.

IV Cases of Curettage in Pernicious Vomiting—Here the result may be largely due to the underlying disease, but the curet may be an added factor, and is extremely dangerous, as the following cases demonstrate

Case XLI—Reported by Dr C U Holmes, Edmonton Primipaia, aged twenty-four years Six weeks pregnant Developed vomiting of a pernicious type and lost 40 pounds under treatment After consultation patient was curetted She came out of the anæsthetic, but the pulse remained weak, and she died 12 hours later

Case XLII —Also reported by Dr Holmes Primipara, once previously curetted for permicious vomiting Again curetted for the same condition Collapsed at the beginning of the anæsthetic, but picked up and the operation completed Patient recovered

These cases are undoubtedly due to acidosis, but the added burden of an anæsthetic and the use of the curet is often sufficient to endanger their lives

A curettage may be carried out when it is indicated, and yet fail to produce the desired result, as the following case will show

Case XLIII—Primipara Two and one-half months pregnant, threatened abortion, and it was not known whether or not the fœtus had come away Curetted and placenta brought away Irrigated and the patient returned to bed The next day a fœtus was passed which had escaped the curet This could not have occurred if the finger or placenta forceps had been properly used

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Thus it is plain that quite a formidable list of accidents with a high death-rate is easily compiled. While some of the bad results may have been attributed to the underlying disease, the curet has to bear the principal blame. My object in reporting these cases is to again emphasize that any intrauterine instrumentation is a dangerous procedure. The indications for such work practically narrow down to the removal of some products of conception or of bits of tissue for microscopic examination, and even here it is probably better to use the finger or placental forceps in the first instance, and it is somewhat doubtful whether the latter procedure is justifiable unless prepared for immediate removal. A curettage is a major operation not to be undertaken except under the very best conditions, and with every possible precaution, by a careful and skilful surgeon.

My thanks are due to the colleagues who so kindly placed their notes at my disposal

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# SURGICAL TECHNIC IN ORTHOPÆDIC SURGERY\*

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ORTHOPÆDIC surgery makes peculiar demands upon us in regard to surgical technic. The operations, if they are to be successful, must be carried out in an aseptic manner. Perfect asepsis cannot be attained, but we can very nearly reach it if we go about our work with intelligence and painstaking care in regard to the smallest detail.

In performing the operations of orthopædic surgery it is frequently necessary to use a good deal of force in correcting the deformity, and no matter how carefully the skin has been prepared, these forcible manipulations will force the staphylococcus epidermis albus from the deeper layers of the epithelium out to the surface where the organism is capable of causing mild infection in the operation wound. An example of this is seen in the correction of a talipes equinovarus, where the foot is stretched and manipulated by the operator's hands or molded over the Konig block or perhaps the Thomas wrench is used. And in order to secure the required amount of correction, it may be necessary to divide the posterior tibial tendon by an open incision and do a plastic operation on the Achilles tendon An operation of this character is usually performed at one sitting In another class of cases the forcible stretching and correction is done at some time previous to the operation and the foot held in its corrected position in a plaster-of-Paris case until a later time, when the tendon transplantation or arthrodesis may be done—as in the infantile paralysis cases

When silk is imbedded in the tissues and we wish it to remain permanently, the slightest infection of the silk will defeat the operation, as the silk will eventually cause suppuration and must be removed. If silk is used as an artificial ligament or tendon, it acts as a foreign body in the tissues. The tissues react to its presence and deposit granulation tissue along the strand. This in time becomes converted into fibrous tissue and we have then a new ligament or tendon of living tissue, the centre of which is the buried silk. The process requires a long time. The limb must remain fixed in plaster of Paris about nine months. The silk will then remain permanently in place. But if the silk is infected with even so mild an organism as the staphylococcus of the skin, it will probably loosen and work its way out or must subsequently be removed.

In opening joints great care must be taken to avoid introducing the

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skin coccus within the joint cavity. Therefore, two knives should be used—one for the skin incision and another to use in the deeper structures

But my purpose in presenting this paper is to call attention to several important ways in which the wound may become contaminated by organisms far more potent than the skin coccus, types of infection which may defeat the operation and even be a serious menace to the life of the patient. The responsibility rests largely upon the nursing staff and the technic of the operating room is good or bad according to the intelligence and ability of the nurses in charge of it

The head nurse must directly and personally supervise the work of her assistants, and the directress of nurses is responsible for the head nurse. The most important feature of a large general hospital is the operating room—and this includes, of course, its personnel

The visiting surgeon in performing a series of operations expects everything to proceed smoothly and without friction—doctors and nurses working in harmony—and all cooperating to secure the best results. When one operation follows another in quick succession—perhaps not five minutes in the interval between them—it is not always possible to relegate the septic cases to the last, as it sometimes happens that infectious material is encountered when it is not expected

A gall-bladder may be septic or an appendix may be lying in a small pocket of pus. A clean pelvic operation may reveal a pyosalpinx. Therefore, in every series of operations one must take it for granted that they may not all be clean cases

The operating-room nurse and her assistants must have absolute confidence in their ability to so conduct the technic that there is no possibility of carrying infection from one patient to another. This requires constant vigilance and can only be entrusted to a highly trained head nurse

In most hospitals it is customary for the directress of nurses to make a daily tour of inspection of the hospital under her charge. She visits the private patients and the ward patients, sees that the wards are clean, looks at the bed linen, walks into the kitchen and pantry, opens the doors of cupboards and closets, inspects the toilet rooms and in a hundred other ways assures herself that the hospital is being conducted in a clean and orderly manner. And yet more important than all these is the operating room, and I would suggest that the directress of nurses occasionally vary her routine and go unannounced into the operating room or the clinical amphitheatre when a series of operations is in progress and remain throughout an entire forenoon or afternoon watching with vigilant and critical eyes every detail of the work of her nurses

In my visits to hospitals in other cities I usually seek out the operating room nurse and, if she can spare the time, ask her many questions in regard to the surgical technic

From a seat in the clinical amphitheatre during a series of operations

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one can also gain a very fair idea of the care and thoroughness with which the nurses have been taught

I will mention some of the weak links in the chain of surgical technic as they have come to my notice in different hospitals, and the fact to be kept in mind is that any one of these weak links is capable of causing a complete breakdown in our surgical asepsis and result in the failure of our efforts to secure clean primary healing of our operation wounds. Of what use is it to insist on our surgical staff, both doctors and nurses, wearing mouth guards, when it is possible to point out faults in the technic by which septic virus may be carried from an infected case to a clean one?

First, then, we will consider the gutta-percha gloves. As the gloves can be sterilized absolutely, it is a good thing to use them. But the most important function of the rubber gloves is to prevent the skin of our hands from being infected with the highly tenacious poison of a septic case, as the skin of our own hands when so contaminated cannot be rendered clean for a clean operation which is to follow. A doctor or a nurse may carry this infection on their hands for several days in spite of all efforts to disinfect them. And it is most important that the hands and forearms of the surgeon and his staff of assistants should at all times be protected from contact with septic material

The preparation of the rubber gloves, therefore, is a matter of the most vital moment. Beginning, then, with a pair of gloves which have been worn during a septic operation—which might have been a ruptured appendix and local peritonitis, an empyema of the gall-bladder or of the thorax, a pyosalpinx, or a dermoid cyst, drainage of an infected knee-joint or opening the thigh-bone for acute osteomyelitis, puerperal sepsis and many other conditions. Poison of this character may remain potent for many days upon rubber gloves, basins, table tops and the like

The infected gloves are washed with soap and water by a nurse who perhaps is handling them with her bare hands. Her hands, therefore, become the carriers of infection, and even though she may not be assisting at operations, she may have a good deal to do with making the necessary preparations for an operation

In some hospitals the nursing staff apparently has implicit faith in the autoclave. The nurses believe—and it is difficult to convince them to the contrary—that everything that comes out of an autoclave must be sterile because it has been exposed to live steam for twenty minutes or a half hour. But the autoclave is fallible. There is a curious and inexplicable inconsistency about the use of the autoclave. The gauze and cotton which come to the hospital from mills or factories, where it is most unlikely they could have become contaminated by any really virulent organisms—probably nothing more than the ordinary dust of a workroom, which is relatively harmless—are put into the autoclave for a half hour on three successive days in order to destroy all germs and spores. The most harm-

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less of all the materials used at the operation are subjected to the most rigid and thorough sterilization

The live steam under twenty pounds pressure penetrates every portion of the cotton, gauze, bandages, sheets, towels, gowns, etc

And now as to the rubber glove It is probably capable of greater harm than any other article which is used at the operation Operating-room nuises have sometimes told me that they depend upon the autoclave to ster-If the gloves have been used in a septic case they are ilize the gloves sterilized for twenty minutes, and if they have been used in a clean case they are sterilized for ten minutes. How the nurse knows whether a case is a clean or a septic one I do not know, because it sometimes happens that the operator himself does not know, and only a laboratory report by the bacteriologist can decide the point. When the nurse is asked why the gloves used in a clean case are sterilized only ten minutes instead of twenty, she replies that the longer exposure to the live steam is harmful to the rubberthat it shortens the life of the glove. She admits that the twenty-minute period is desirable for the septic gloves, but she does not and cannot know whether the gloves are septic or not in some cases. The gutta-percha is impervious to steam. The gloves are sometimes folded twice upon themselves and bound up in a small muslin package and a pile of these are packed into the autoclave Now it is entirely probable that the live steam reaches all the parts of the outer surface of the glove, but I believe there are air pockets inside the glove—probably in the fingers or thumbs—which the steam never reaches These air pockets therefore permit only dry heat sterilization instead of moist heat sterilization for twenty minutes And the nuise knows that she is dealing with a glove which has been used in a case which was frankly a septic one She runs her autoclave at about twenty pounds pressure This provides a temperature of approximately 260° in the sterilizing chamber This is moist heat sterilization

We know that boiling water (210° F) will destroy all organisms and their spores in five minutes. The nurse therefore believes she has a wide margin of safety. But she overlooks the air pockets inside the gloves. These are receiving only dry heat. In order to destroy all germs and their spores by dry heat an exposure of about one hour at a temperature of 350° F is required. The autoclave falls short of this by nearly 100° in temperature and forty minutes in time

The surgeon, on putting on his gloves, may find when he opens the package that he has two rights or two lefts through an oversight on the part of the nurse who prepared them and proceeds to reverse one of them, thus bringing the surface of the glove which may not be sterile outside, in contact with the operation field. Or, during the operation the finger of the glove may be punctured or torn and the result may be the same. In order to avoid all possibility of doubt as to the glove being sterile, we have the nurse wash the gloves with soap and water, turning them inside out while

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doing so They are then filled with water to remove the air and immersed under the surface of boiling water and held down by a piece of wire screen so that they cannot float up to the top and be exposed to the air

They are boiled five minutes by the clock. When the water cools, the nurse, wearing sterile gloves, removes them, dries them with a sterile towel, powders them inside and out with sterile talcum powder and folds back the gauntlet. Into this she tucks loosely a small gauze pad covered with talcum powder which the surgeon uses for dusting his hands. The gloves are then placed without folding in a muslin cover and put into a large glass jar. The final preparation is just before they are needed for an operation. The muslin packets are placed full length in the autoclave, lying loosely in rows, not packed together in compact bundles, and sterilized for twenty minutes. The steam easily reaches every part of the glove and the dusting powder also. The surgeon can have absolute confidence in these gloves—there is no possibility of their carrying septic material from a previous operation.

There is another object which may be a carrier of a deadly virus and that is the sand pillow It usually has a rubber or mackintosh cover When it is used in a septic operation—as in an acute osteomyelitis or the drainage of an infected joint or necrosis of bone—the discharges from the wound soak through the sheets or towels and soil the sand pillow. The stains are wiped off with a wet cloth later before the nurse puts it away upon a shelf, but no attempt is made to sterilize it. Within a day or two the pillow may be called for again This time the surgeon is going to remove a bone graft from the tibia to be inserted into the spine, or he finds it a convenient support in doing an arthrodesis on the foot The most rigid asepsis is required A nurse brings in the sand pillow, the surgical nurse wraps a sterile cloth about it and it is placed under the patient's limb. So long as the sterile cloth remains dry no harm results But it does not remain dry may run down upon it from the wound, or wet gauze sponges come in contact with it, instruments which have been rinsed in the basin of sterile water may be placed upon it, the surgeon washes his gloved hands in the sterile water and returns to the operation with his gloves dripping, and so the coverings of the sand pillow become wet It is then only a matter of five or ten seconds before the operation field becomes contaminated with the poison of the septic case of the day before I usually demonstrate this to my class of students by making a red ink stain on the sand pillow and allowing it to dry The pillow is then covered with a white cloth and a wet gauze sponge is dropped upon it In from five to ten seconds the red stain is seen coming through and by the end of two minutes the surrounding areas are red and the gauze sponge stained through and through, although it is fourteen layers of gauze in thickness. The demonstration is very simple and absolutely convincing This same principle applies, of course, to the tops of the tables upon which the instruments are placed and also the top of the operating table Very often this latter is covered with a rubber

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pad and this in turn with a clean sheet. If the operation happens to be upon a patient's lower limb, the limb is painted with a 3 per cent solution of iodine while an assistant holds it up with a sterile towel. Then the surgical nurse covers the operating table with a sterile cloth—probably folded to make it double thickness and the limb is put down upon it. If the rubber pad has been soiled from the discharges of a septic case, our clean operation will almost certainly be infected as soon as the table coverings get wet. When one considers the character of the operative cases which come and go in the general routine of the operating room of a large general hospital, the great care which must be exercised by the nursing staff must be apparent.

In a single week there may be a series of operations which includes an operation for gall-stone complicated by an acute septic cholecystatis, the removal of a pyosalpinx, removal of a papillomatous ovarian cyst or a dermoid cyst, a child with ruptured appendix and acute peritonitis, a child with mastoid abscess, another with empyema, and many other similar cases, and all along the clean cases are being operated upon. It is an advantage to have one operating room set apart for septic cases, but even this does not overcome the difficulty However, the measures to avoid carrying infection from one case to another are simple. There should be a rubber cover provided for each table They should be sterilized just as the gloves are The rubber cover is in turn covered with a sterile cloth is true for the sand pillow. The operating table may be covered with a sterile folded blanket and on top of this the sterile sheet folded double a sterile rubber cover may be placed over that part of the operating table which is in the neighborhood of the operation and upon this the sterile folded sheet

This same procedure is followed for each operation

The instruments are sterilized for ten minutes by boiling them in water to which a tablespoonful of carbonate of soda has been added. Only the instruments which will be required for the operation should be prepared. It is a disadvantage to sterilize a large number of instruments which are not likely to be used. They unnecessarily complicate the use of the instrument table, and it is also hard on the instruments. The knives are not boiled. After being used they are carefully washed before being put away. They are sterilized for operation by immersion for twenty minutes in a 1/20 carbolic solution or 3 per cent formalin. They are removed by a sterile forceps to a tray of 85 per cent alcohol. This seems to be a safer plan than to depend upon the alcohol tray alone and particularly if the knife has been used previously in a septic operation.

Silk may be prepared by boiling it for ten minutes in a 1/1000 bichloride solution and then for ten minutes in plain water. If the silk is boiled with the instruments to which the soda has been added its tensile strength may be impaired.

The catgut should preferably be obtained from the manufacturer in

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sealed glass tubes These tubes when handled become coated with a thin layer of grease from one's fingers and in this thin film living organisms or spores may be imbedded and perfectly protected from the action of antiseptic solutions. It is not enough, therefore, to place these tubes in a tray containing carbolic solution or formalin solution. The germs are not destroyed and the nurse, when she takes up the tube in her gloved hands and breaks it protected in gauze, is very likely to contaminate her gloves and as she removes the strand of catgut and draws it out through her fingers she may in turn carry the organisms along the catgut. Infection from the suture may result. This is avoided by boiling the glass tubes of catgut with the instruments. They are then placed in a tray of 1/20 carbolic solution or 3 per cent formalin.

At the operation the nurse removes a tube of catgut from its tray by using a sterile forceps. She should never put her fingers into the tray Silkworm gut is boiled with the instruments, also the rubber drainage tubes

The white enameled basins are sterilized in the utensil sterilizer and a fresh set is used for each operation

The large glass bowls which are seen in many operating rooms should not be used. There is no reliable way of cleaning them if they become contaminated during a septic operation. The few minutes intervening between one operation and the next do not give the operating-room nurse sufficient opportunity to render them surgically clean.

Mouth guards are worn by the surgeon and his assistants. The speaking voice is capable of projecting minute particles of saliva which carry organisms a distance of three feet, a cough or a sneeze two or three times that far. It seems unlikely that quiet breathing through the nostrils can infect a wound and it hardly is necessary to wear a mask which covers both mouth and nose. As the surgical nurse assists at the operation and sometimes finds it necessary to speak to the surgeon or his assistant, she may speak directly upon the suture which she is holding at the moment only a few inches away from her mouth. It is quite important, therefore, that she also should wear a mouth guard. The same applies to the anæsthetist if the operation is upon the head or neck or shoulders.

And finally it is worth while to mention the very mild infection which may be carried by sweat. It has never seemed to me that this is a serious menace, and yet it is possible that our catgut ligatures or sutures may become infected in this way and prevent the clean healing of the wound

The sweat may come from the patient's skin as well as from the forearms of the operator or his assistants. No matter how carefully the surface of the patient's skin or the hands, forearms and arms of the operator and his assistants and nurses may be prepared, when the sweat glands begin pouring out their secretion until the sweat collects in droplets there is always a little risk of very mild wound infection

The climate of Philadelphia is very hot in July and August, and it is not unusual to find ourselves working in an operating room with the tem-

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perature near or even above 100° F The air, furthermore, is saturated with moisture. A leaking skin is inevitable under these conditions. The sleeves of one's gown may become saturated or occasionally a drop of sweat may fall from the gauntlet of one's glove upon the field of operation. Under such uncomfortable conditions, I have found it an advantage to wear a gown with short sleeves and work with gloves and with the arms bare to above the elbows. During the operation I frequently rinse off my gloves and forearms to the elbow in the bichloride basin. The skin of the patient surrounding the immediate field of operation should be frequently mopped with a wet bichloride sponge.

Talcum powder cannot be sterilized in bulk. In the laboratory of the University Hospital we have been able to obtain living spoies from the central portion of a box or shaker of talcum powder even though it had been repeatedly "sterilized" in the autoclave. The moist heat cannot penetrate the powder sufficiently to kill the spores which may be lying deeply imbedded in it

Following is the surgical technic which I outlined for the assistance of our nursing staff in the Orthopædic Department of the University Hospital about two years ago We have found it satisfactory in every way

#### SURGICAL TECHNIC-WARD L

The Patient—The day preceding In the morning give drams two of castor oil, or dram one of aromatic fluidextract of cascara sagrada, and late in the day give a simple enema. In the afternoon prepare the region of operation. This means the whole extremity. In preparing the foot, pay particular attention to the toes, between the toes, the toe-nails, etc. First scrub with functure of green soap and sterile water—using gauze sponges—for ten minutes. Follow this with sterile water, then scrub and thoroughly douche the part with a warm 1-2000 solution of bichloride of mercury, douche with sterile water and sponge with 85 per cent alcohol. The limb is then covered with dry sterile gauze and bandaged

The day of operation A cup of broth or hot milk about 7 30 A M Water up to within two hours of operation On the operating table, the sterile dressings are removed and the limb painted with a 3 per cent tincture of iodine

The Operating Room Staff The surgeon, the assistant surgeon, the resident surgeon The head nurse, the surgical nurse, the clinic nurse

The resident surgeon acts as first assistant to the operator

The assistant surgeon handles the instruments and acts as second assistant

The head nurse is in the operating room throughout the operation and keeps a general supervision of the nurses and the operating room

The surgical nurse has charge of the nurses' table and assists at the operation as required. She handles the sterile sheets, sponges, sutures, ligatures, needles, needle-holder, scissors, etc. She never touches anything which is not sterile. She wears a fresh sterile gown for each operation. At the end of an operation she removes her gloves. She disinfects her hands and puts on fresh gloves just before the next operation is to begin. She wears a mouth guard

The clinic nurse does whatever is required in the operating room where sterile hands are not necessary

The Operating Room The washbasin and stands are scoured with "Sapolio" or "Old Dutch Cleanser," or some similar cleansing agent, and the metal parts kept bright with metal polish

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Only white-enamel basins are used in the operating room and these are sterilized in the utensil sterilizer

On one table there are three basins No 1, a warm solution of bichloride of mercury, 1-1000, No 2, alcohol, 85 per cent, about one-half inch deep and with several gauze pads, No 3, sterile water

The bichloride solution should be stained a faint blue, or be marked by a float

"Bichloride of Mercury, 1-1000"

On another table is a basin of sterile water which is to be used during the operation. This must always be replaced by a fresh basin for each succeeding operation.

The Nurses' Table The table is covered with a sterile cloth, and on it are placed

- I A tray containing packages of rubber gloves of various sizes and the sterile dusting powder
- 2 A jar or tray of catgut in glass tubes of various sizes. These may be covered either with a 3 per cent formalin solution or a 5 per cent solution of carbolic acid. The tubes when wanted are removed from the jar or tray with sterile forceps.
  - 3 A jar containing silk of different sizes and kept the same as above
  - 4 A jar of rubber drainage tubes, and kept the same as above

For each operation the surgical nurse spreads a fresh sterile sheet or cloth across the front half of this table, and upon this she places the fresh sterile tray which contains the scissors, needle-holder, needles, and a glass tray which contains the scalpels and tenotomes covered with alcohol. The nurse touches nothing on this table except the two trays and their contents and the sterile sheet upon which they rest. She must be careful not to contaminate the contents of any of the glass jars or trays which contain the catgut tubes, etc, but must always remove what she requires with sterile forceps. These forceps are, of course, re-sterilized with the other instruments before the next operation.

At the close of the operation, then the two trays and the sterile sheet are removed, to be replaced by fresh ones for the next operation

Nothing which may have come in contact with one operation—either directly or indirectly—is to be permitted to come in contact with the following operation, either directly or indirectly

The Instrument Table The instrument table should be covered with a sterile rubber cover and over this a sterile sheet, and upon this are arranged only the instruments which are required for the operation. At the end of each operation everything is removed from this table.

Sterilization—The gauze dressings, gauze sponges, towels, sheets, gowns, etc, are sterilized in the autoclave by live steam, followed by dry heat—Each operation is to have its own separate drum—One drum may be used solely for gowns of nurses and doctors, and this may remain in its position on its stand throughout the series of operations

The instruments (which include everything except the knives) are sterilized by boiling for ten minutes

The knives and tenotomes are covered with a 3 per cent solution of formalin for 20 minutes. This is poured back into the stock bottle and the knives are covered with alcohol until used. The tray which is used is sterilized in the utensil sterilizer.

The Rubber Gloves—These are washed with soap and water to remove all stains, turned inside out and washed again. They are then filled with water and put into a vessel of boiling water with a wire frame on top of them, so that they cannot float up on top of the water. They are boiled 5 minutes by the watch. When the water has cooled, the nurse, wearing sterile rubber gloves, removes the gloves from the water and dries them with a sterile towel, of course turning them inside out in doing this. The glove is dusted inside and out with sterile powder and folded in a piece of sterile muslin and made into a packet. These are then placed in a large glass jar having a glass cover, and put away until they are needed for operation. They are then put

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into the autoclave and sterilized with the surgical dressings during their final sterilization. The gloves need not be left in the autoclave longer than 20 minutes

The glass tubes of catgut may be sterilized with the instruments and then placed in carbolic or formalin solution

Drainage tubes should be boiled to minutes and then placed in the formalin or carbolic solution

Silk, if it is to be left buried in the tissues, should be boiled for 10 minutes in a 1-1000 bichloride solution, and then for 10 minutes in water

#### INSTRUMENTS REQUIRED

For every operation have ready the following

2 pairs of retractors 2 pairs scissors, blunt ends—I pair curved and I pair straight 2 scalpels 2 tenotomes—I sharp-pointed and I blunt I Allis dry dissector I grooved director 12 hæmostats 4 curved hæmostats I small probe I periosteal elevator 4 tenaculum forceps 4 Allis forceps 1 needle holder 2 dissecting forceps needles 2 rat-tooth I ligature carrier

Additional instruments are required for certain operations as follows

Tendon transplantation	Osteot
I long, very slender pair of forceps	I

I long probe with eye
I drill handle and 3 drills
I very narrow osteotome

Arthrodesis and transverse horizontal

All the preceding instruments and also

I medium gouge
I small gouge
I medium chisel
I small chisel
Bone grafting

Bone grafting
I Hey's saw

I osteotome—medium
I osteotome—small

I chisel

I mallet or hammer

I bone-cutting forceps

#### Osteotomy

I osteotome—large
I osteotome—small
I osteotome—medium
I hammer or mallet
I Konig block

I sand pillow Arthroplasty

2 saws
2 chisels
2 gouges
I curette

I bone-cutting forceps
I hammer or mallet

1 drill

8 extra hæmostats

Erasion of a joint

Same as Arthroplasty and

I hon-jaw forceps
I sequestrum forceps

Talcum powder cannot be sterilized if it is in bulk, that is, in the dusting can The talcum powder should be spread on a gauze sponge in a very thin layer and then placed on top of the rubber gloves just before they are enclosed in the muslin covering

#### WAR SURGERY OF THE ABDOMEN

CUTHBERT WALLACE, Consulting Surgeon of the British Armies in France, has published in an octavo volume of 152 pages (Philadelphia P Blakiston's Son & Co), a study of the experiences during a period of thirty months extending from July 1, 1915, to December 31, 1917, in abdominal surgery of the sector of the battle line under his surgical control

The number of cases upon which the study is founded is 1098 abdominal wounds The object of the study is to determine what benefit may be expected in dealing with these cases by operative means All cases occurring within the particular sector involved are included, no matter at what hospital they are treated It goes without saying that the results are greatly influenced in different hospitals by their respective distances from the firing line They differ greatly, also, according to the nature of the fighting They are nearly always worse at the end of a fight than at the beginning, for the cases at the end are difficult to collect, and are, therefore, late in arriving Again, if times are quiet, there is plenty of time to treat all cases adequately and deliberately, the conditions being quite different from those in which active operations are in progress, when it may be only possible to pay attention to the most favorable cases It is necessary, also, not only to reckon the mortality following operations, but also the mortality in those cases in which no operation was performed The statistics obtained are the result of a system whereby every hospital which was called upon to treat abdominal cases was provided with a book in which certain headings were written down, which were filled in at the time of operation by the medical officers

In the earlier months of the recent war an expectant method of treatment was generally adopted Operations were secondary or late A wounded man was first received by his regimental medical officer to whom he was brought in the regimental aid post, situated somewhere in the trench system, thence he would be transferred by stretcher to an advanced dressing station, usually situated just behind the trenches, thence by car to the field ambulance, where he was kept until the arrival of a motor convoy (often only once in twenty-four hours), by which he was taken to the casualty clearing station, which was the first place adequately equipped for operative Here there was reasonable possibility for the performance of any operation thought advisable In some cases, with the idea of avoiding a disturbance by movement, a man wounded in the abdomen was kept at the regimental aid post, often he was kept at the field ambulance, but usually he was transferred to the casualty clearing station as soon as possible Here the usual procedure was to put the man in the Fowler position, to improve the general condition by rest and warmth, to withhold food and water for three days, and to administer morphia Thirst was combated by rectal salines and mouth-washes The result was that many patients at first gravely ill went through a period of improvement which often was very striking, so that it was possible to evacuate them to the base hospital Here they arrived sometimes in good condition and sometimes gravely ill, as a rule, they became worse and worse, and in the end died

In 1915 a series of operations and post-mortem examinations showed that the intra-abdominal injuries were of such a nature that recovery was not to be expected without surgical aid except in a few instances

Hemorrhage was a frequent cause of early death. The injuries produced by bullets often were very extensive, negativing the prevalent opinion as to the comparative smallness of the lesions produced by a modern small-bore bullet. Appreciation of the large part which hemorrhage played in causing the early death after such

injuries emphasized the necessity of the earliest possible operative interference for its control. Directions to use all possible celerity in forwarding all abdominal wounds to the nearest casualty clearing station were followed by rapid improvement in the results obtained

With regard to the relative frequency of abdominal wounds, experience in the present war has been that the number of such wounds that reach an operating hospital is not likely to exceed 2 per cent of the total wounded received, provided no segregation of such cases is practiced

It has always been a much-debated point as to whether a projectile could traverse the peritoneal cavity without wounding the hollow viscera. The result of the large number of cases in which, after perforating wounds, the abdomen was opened and explored, is that in a number of them no hollow viscus was found injured, although the abdominal cavity was usually full of blood. In some of them the injury was limited to bruises and tears of the peritoneal and muscular walls of the stomach or intestine. It is not denied that in rare instances spontaneous recovery after wounds of the hollow viscera has occurred. Wallace gives the details of a number of such instances, but the number is too small to have any practical bearing upon the indications for treatment in any given case.

The relative frequency in which the different organs of the abdomen are wounded, from a total of 965 cases, is as follows Small intestine, 363, colon, 252, liver, 163, stomach, 82, kidney, 74, spleen, 54, bladder, 45, rectum, 21, pancreas, 5, ureter, 3

Most cases succeeded in reaching the casualty clearing station some time between six and ten hours after receipt of the injury. The statement is made that up to six hours the chances are in favor of the patients, after this period they are always against them. So far, the limit in successful cases has been forty-eight hours for resection of the small intestine and thirty-six hours for a suture of the colon and for a suture of the stomach.

Notwithstanding the realization of the fact that the sooner a man is operated upon the better, there is another factor, namely, the aftercare of the wounded man He must be kept quiet and well nursed. While it might be sometimes physically possible to operate upon him at the regimental aid post or advanced dressing station, it would be under the most disadvantageous circumstances. After operation, nursing as usually understood would be impossible. In addition, the man would be under constant shellfire or close to our own guns. To avoid delay in such and other cases of severe wounds, the advancement of the casualty clearing station reasonably far forward is important. In some instances it has been possible to establish special hospitals in advanced positions.

With reference to abdominal wounds, the author states that the French and the Belgians have gone through the same experience as the British Since the fighting line became fixed, operation has been the accepted practice Advanced abdominal hospitals have been established at some centres

As regards the diagnosis of intra-abdominal damage, experience has shown that one has to be very careful in making a negative diagnosis, and it has also shown the wisdom of operation in doubtful cases. Though a man hit in the abdomen usually looks ill, he sometimes appears to have no serious lesion. Sometimes he is apathetic and quiet, sometimes restless. He may be blanched, or of a fair, clear color, even normal in appearance. He may present a good facial expression, even though his extremities are cold and clammy, and the pulse imperceptible, and death imminent

When the patient has once arrived at an operating hospital, it is better to put the man to bed and watch his condition for a time rather than to immediately subject him to operation. The first and foremost indication is to secure the warming of the patient. This is by far the best treatment of shock, and greatly excels in value the administration of stimulants of whatever nature. If heat, rest and morphia do not improve the man's condition, it is doubtful if transfusion or infusion will produce

any effect, except in cases of severe hemorrhage, when transfusion of blood is by far the best restorative

The actual moment for performing the operation must be left to the individual judgment of the operator. If the man does not respond at all, the question must be decided whether it is best to operate at once, or whether it is worth operating at all. Frequently some hours will produce such improvement that an operation is possible, where at first the case seemed hopeless. Experience has shown the wisdom of operating as a routine measure. The main question is, What case is it best not to operate?

It is true, also, that there will be some patients operated upon who are not found to have any visceral injury, and some in whom the wounded parenchyma of solid organs has ceased to bleed

There are, of course, many cases in which no surgeon would feel himself justified in operating, but there are many borderline cases which some surgeons would leave and others would feel constrained to submit to operation. The bolder surgeon may get the worse operative mortality, and yet save more lives

Wallace accepts twenty-four hours as the usual limit within which a primary operation is likely to be successful. By this time hemorrhage will have ceased, and operation is only to spread infection, if the bowel has been perforated, and to hasten the end

With reference to wounds of particular organs, out of 965 cases operated upon, the stomach was perforated 82 times, in 55 of which it was the only hollow viscus damaged. In cases uncomplicated with wounds of other hollow viscera, the mortality was 527 per cent. The small intestine in this same series of operative cases was found wounded 363 times, in 255 of which it was the only hollow viscus wounded

Single lesions are the exception Out of 124 cases, the average number of lesions was 48. The greatest number of lesions was 20. The lesions are usually collected close together, but sometimes they are disposed in two or three groups, which necessitate multiple resections.

As a rule, the whole length of the small intestine must be explored. Suture should be practiced when possible. Small discrete injuries, however numerous, should be sutured. It is also better to narrow the bowel than to resect, even if it involves a lateral anastomosis. Resection should be reserved for cases where the bowel is practically destroyed, where there are several severe injuries or complete divisions close together, and where injuries extending into the mesentery or infarction of vessels give no choice. A single row of stitches is practically all-sufficient in the suture.

In the 965 operative cases under consideration, the colon was wounded 252 times. In 155 cases it was the only part of the alimentary tract hit. The injuries of the large intestine are similar to those of the small gut. The differences that are to be noted are due to its larger size and the absence of coils, to the absence of mesentery in portions of its course, and its proximity in some portions of its extent to bone

With regard to the treatment of colon cases, the author is of the opinion that, although some unoperated colon cases did recover, nevertheless these cases cannot now be advanced as a ground for abstention from operation except in cases which arrive late

The mortality of colon cases uncomplicated with other lesions of the alimentary tube is 587 per cent. Where the simple suture has been possible, the mortality was only just above 50 per cent. When a colon anus was required, the mortality was 735 per cent. This increase in mortality in cases of colostomy is due not to the character of the operation itself, but to the fact that progressive sepsis was not prevented from infection already started when the colostomy was performed

The bladder was perforated 45 times in the 965 operated cases, and in 25 cases was the only organ injured. Of these 25 cases, 14 died

Shock and hemorrhage form the causes of death in the majority of cases

In addition to the abdominal injuries, every kind of bodily injury may also be present in individual cases. Compound depressed fractures of the skull, fractures of the long bones, multiple wounds, fractured spine, avulsed limbs, are among such complicated injuries, but for such extraneous injuries the mortality in the cases studied would be considerably lower.

Hemorrhage stands out as the great source of danger. In wounds of the stomach, damage to the vessels running to the stomach wall before they penetrate it and to the big vessels lying on the two curvatures may give rise to very great hemorrhage. The omental vessels may be a source of hemorrhage. The small intestine wall is the source of considerable hemorrhage. The mesenteric vessels give rise to very considerable hemorrhage. A mesenteric wound often includes also a wound of the big vessels, such as the colics, and it is the most common source of blood in the abdomen when cases come to operation

Hemorrhage in the retroperitoneal tissue is a source of great trouble. The formation of extensive hæmatoma is common. The deep epigastric artery of the abdominal wall may be the source of hemorrhage. The great intra-abdominal vessels may be injured. The parenchyma of all solid organs bleeds freely at first, but if no large vessel is injured, the hemorrhage may be expected to cease spontaneously in a few hours.

Peritonitis is the usual cause of death after the period of shock and hemorrhage is over. The amount of peritonitis present when an operation is done at an early stage varies much. It is not so dependent upon the time elapsed since the wound as might be expected. Infection may be due to contamination from the bowel, to dirt carried in by the projectile, and, finally, from the operation wound itself from fault in technic.

There are many other points of detail which are discussed in this little book Every page is full of interest, being a study on a large scale of a vast experience—experience which was possible to be gained only under the conditions of a great war such as that which has been waged during the past four years and more. The abrupt closure of the war has made its lessons less pressingly important upon the clinical side. As one reads the details of the conditions in which much of the work here recorded has been done, one is filled with admiration of the high spirit of devotion with which the surgeons of the Allied forces have applied themselves to their work

Every one will gladly adopt the language of the author when he pays compliment also to those who collected and bore the wounded from the field to points of relief What success the surgeons have obtained, he says, is due mainly to the magnificent way in which the wounded have been collected by the bearers. One cannot sufficiently express one's admiration for their courage, steadfastness and endurance. The motor ambulances of the field ambulances and of the motor convoys deserve great credit. What praise is not due to the drivers, who, in darkness and shellfire, tenderly picked their way among the holes in the road so as to avoid a needless jolt to their wounded charges? The book as a whole is fittingly dedicated to "The Stretcher-Bearer"

#### THE LATE RESULTS OF GUNSHOT WOUNDS OF THE CHEST

As an addition to the contributions to the immediate surgery of wounds of the chest which were the subject of editorial comment in the November issue of the Annals of Surgery (pp 554-562), interest will attach to contributions upon the late sequelæ to such wounds, which form a series of papers published in the Lyon Chirurgical for May-June, 1918

In the first paper (Récherches climques et radioscopiques sur certaines sequelles lointaines des plaies pleuro-pulmonaires de guerre), the authors, MM Pehu and Daguet,

deal with certain consequences found present several months after the traumatism had been sustained and when every evidence of bony, bronchial, pulmonary, or pleural disturbance of a suppurative or inflammatory nature had ended, when cicatrization had been accomplished, but when in most of the cases there could still be observed a tendency to slow spontaneous betterment, the cicatricial condition not yet having become definitely fixed Various recent papers have treated upon the general subject of the later consequences of thoracic wounds They show that, to the acute immediate phase succeeds a period during which, at least in a certain number of them, it is quite frequently the fact that subacute manifestations may be found showing that the process is not fully and completely terminated. The authors of the present paper have studied such sequelæ of thoracic wounds with the special idea of contrasting results in those in which there were present sero-fibrinous effusions of infectious origin, with those which were bloody and purulent in their nature from whatever origin they may have spring In all the cases studied by them, several months (four at least) had intervened between the reception of the wounds and the time they came under the authors' observation The acute phenomena had ended, pleural suppuration had ceased, and the bronchial manifestations had been suppressed

The problem was then to estimate the physical value of the individual as to final restoration to health, or as to the necessity for excluding him from the list of possible future combatants. The material was composed of soldiers of from 20 to 40 years of age belonging to all classes of fighters. Of these they have examined in all 146 in the space of twenty months.

As to the nature of the missiles which had inflicted the wounds, shell fragments were much the most frequent, being from 85 to 90 per cent. The rest were rifle balls, or fragments of shrapnel or hand grenades, or similar agents.

Out of the entire number there was but one wound from a revolver ball, and one dagger wound

As to the clinical symptomatology presented in these cases, the physical signs are identical with those in chronic pleurisy from whatever cause. The symptoms are in general not well marked, a dulness scarcely appreciable, or an ill-defined diminution of the respiratory murmur One does not note the frank dulness which accompanies certain forms of parietal adhesions, especially at the base. Auscultation reveals a varying degree of respiratory suppression. As to fremitus, it is always appreciable to a degree more A phenomenon quite constant, noted even in the least severe or less pronounced cases, consists in the diminution of expansion of the half of the thorax corresponding to the wound This sign is not sought for as often as it ought to be a very great value in directing research. It is noteworthy that there does not exist a close parallelism between the data furnished by the X-ray and the mobility of the corresponding half of the diaphragm A thorax may present the least degree of mobility while the muscular curtain is but little paralyzed. Inversely, certain thoracic frames may dilate to a sufficient degree while the diaphragm is almost mert the supplementary activity, more or less efficient, of the accessory respiratory muscles

Besides these particulars revealed by physical examination of the thorax, signs of persistent bronchitis or chronic pleurisy have been rarely noted. Generally, it may be said that the objective physical signs referable to the framework of the thorax are always less characteristic, more imperfect, than the signs revealed by the X-ray. The signs obtained by radiographic examinations merit careful study. They show exactly the functional value of the pleuro-pulmonary apparatus and serve as valuable guides in an estimation of the later course of the case.

In a certain number of cases the presence of metallic foreign bodies was shown, situated in various portions of the thoracic cavity, of which, in the opinion of surgeons, extraction was judged useless or dangerous. Of the 146 cases under examination, there were 27 bearers of intrathoracic projectiles. These foreign bodies were apparently well tolerated and around them there could be seen no modification of the radioscopic

image of the intrathoracic viscera. In one case only was noted the existence of a grayish halo around a foreign body

The clinical signs, therefore, as far as the sequelæ of wounds of the chest are concerned, are of much less importance than the signs revealed by radioscopic examination. The fluoroscope screen shows often conditions unsuspected by external investigation alone, and to arrive at an exact conclusion as to the anatomical and physiological characteristics of the ultimate results radioscopy is essential. The screen examination makes possible the determination of the degree of alteration of the diaphragm, of the pleural culs-de-sac, of the pleura itself, etc.

The authors have divided the thoracic wounds studied into two classes (a) Those which have been accompanied by a purulent pleurisy subjected to incision, and (b) those which have not undergone any surgical intervention. The sequelæ consecutive to wounds complicated with empyema do not entail changes much pronounced and very extensive. Most frequently may be observed shadows localized along the sinus, a slight thickening is at the base of the lung, a little diaphragmatic inertia betraying itself to external examination by the least signs of chronic pleurisy. One was often surprised to find that empyemata which had suppurated for many months, left behind them slight signs, that the play of the diaphragmatic dome is very little altered, that the stroma of the lung is scarcely rendered grayish. Even if the incision of the purulent collection has been more or less delayed, if, according to all probability, it has been preceded by a period of simple hæmothorax, nevertheless, the remnants left are minimal

The most favorable conditions, the minimum of sequelæ, have resulted from interventions in which pleurotomy had been accompanied by costal resection. Rib resection is indispensable to permit sufficient drainage through the rubber tubing introduced more or less deeply into the chest. Division of the skin, muscular planes, and incision of the pleura without touching the ribs is not sufficient.

As to the wounded who present no operative cicatrix, a considerable number of the penetrating wounds, whether accompanied or not with bloody effusions, left no important sequelæ

A special study has been given to the frequency of the development of pleuropulmonary tuberculosis as a sequelæ to the injuries of the chest. Of the 146 cases under examination there were observed three cases of pulmonary tuberculosis and two cases of sero-fibrinous pleuritis of an undoubtedly tuberculous nature. It was impossible to say positively, however, whether these cases were dependent upon the injury received or not

## THE EARLY TREATMENT OF SEPTIC PLEURAL EFFUSIONS COMPLICATING PENETRATING WOUNDS OF THE CHEST

(Note sur le traitement précoce des épanchements septiques de la plevra, complications des plaies pénétrantes de poirrine)

Messrs V Combier and J Hertz (Aide majors à l'Ambulance automobile 13) report their results in the early closing of the thoracotomy wound in cases of septic pleural effusions as soon as the pleural cavity had been rendered sterile by drainage accompanied by irrigations after the method of Dakin According to their experiences, sterilization of the pleural cavity can be accomplished very rapidly if it is begun early The objectives to be attained were to empty and disinfect the pleura, to close it, and to mobilize the lung

Only in cases in which a wounded man retained within the thorax a large missile likely to be poorly tolerated, and especially likely to reinfect the wound, did they practice the extraction of the missile, if it did not necessitate deep penetration into the lung. In this course they were influenced by the theory that the extraction of an intrapulmonary projectile was less grave in its consequences when the inflammatory process has disappeared. Again, whenever the cause of pleural infection could be

traced to an infected focus attending fracture of the ribs, they excised this complicating focus. If the focus is a fracture of the scapula, its clearing out is still more necessary on account of the muscular masses which surround it. The presence of a fracture of the rib in a chest wound which it continually aggravates is of itself alone an operative indication after the arrival of the patient at the hospital

The time for surgical intervention has in all cases been controlled by bacteriological and cytological examinations made by the chief of the laboratory service. The results of these examinations have served as controls when compared with the later examinations practiced upon the pleural fluids after the Dakin irrigations. These examinations have furnished information as to the transformation of the pus and its flora, the progressive diminution of the number of germs

In all cases the closure of the wound was done only when the number of microbic elements had become very minute, and when the percentage of white corpuscles showed that the proportion of the poly- and mononuclears had become normal

Operative Technic —It is supposed that, before any intervention, X-ray examination has been done to secure information as to the quantity of intraperitoneal liquid, as to the presence of the projectile, or of fragments of the ribs. The authors have always employed by preference local anæsthesia, with I per cent solution of adrenalized novocain, accompanied by one or two hypodermic injections of morphin, one at the beginning of the local anæsthesia and a second in the course of the intervention, if it seemed necessary. An important effect of such hypodermics of morphin the authors believe to be the prevention of reflex nervous accidents due to spasm of the cerebral arteries with transitory ischemia, which the production of the pneumothorax may entail

The first step is the resection of some cubic centimetres of the ninth rib in the posterior axillary line, preceded by an exploratory puncture at this level to make sure that the drainage would be effectual. Once the rib has been resected, they make a pleural incision, which is begun with the point of the bistoury and prolonged pro-In the case of thoracotomy for purulent pleurisy, the ingress of the air into the pleural cavity is little to be feared. The wounded lung is already prepared by the previous progressive compression due to the effusion The thoracic equilibrium has already been broken and it would not be subjected to the three great causes which explain the accidents due to the opening of the pleura, namely, deviation of the mediastinal diaphragm, air embolism in the circulation, the production of pneumothorax After the liquid has been evacuated and direct finger examination has been made, the careful removal of false membrane is instituted. Inspection of the cavity to make certain that it is free from retained masses may be made by suitable light. Then they put in place the irrigating tube and the drainage tube The latter descends into a reservoir containing at its bottom liquid which may produce suction to keep the pleura dry and to draw the lung to the wall of the chest This pleural drainage tube is of the calibre of the index finger It should penetrate into the pleura five good centimetres, it should have three large, long fenestra, it should be extremely soft, so that it may cause no irritation. Into its large lumen may engage clots and false membranes. It is fired to the skin by a point of silkworm gut

The irrigating tube is a long tube which, in the majority of cases, passes up into the pleural cavity through the operative wound 20 centimetres, toward the summit, where it is fixed by a point of silkworm-gut suture

In cases of recent pleurisy, or those in which diverticula are absent, one irrigating tube may be used instead of the multiple tubes which have been recommended. By several points of suture involving the pleural muscles and skin the wound is hermetically closed about the tubes. Upon the closed operative wound through which emerge the two tubes two long compresses are placed and the whole is covered over by a plate of pure rubber, perforated by two openings, through which come out the two tubes, the drainage tube going to its bottle, the irrigating tube fixed to the shoulders and kept closed between the times of injection. The circumference of the rubber

plaque is fixed to the skin by cement. By means of this arrangement all the pleural liquid, pus and Dakin fluid passes into the drainage bottle, the bed is not soiled and reinfection from the wound is rendered impossible. It is sufficient after three days to change the two compresses which rest upon the skin. The patient is put in bed in the sitting position. The end of the drainage tube is placed in a bottle filled one-third full of antiseptic liquid. During the first day there are made five instillations of 20 cc of Dakin fluid, two more during the night, the same again the second day, with the addition of one transpleural irrigation of from 250 to 500 cc of the Dakin fluid at one time. This is continued to the fourth or fifth day, when the number of instillations is reduced to four, of from 20 to 50 cc each day. Never has it been found that these irrigations caused functional troubles. The patient bears them readily and often expresses a feeling of comfort from their use. The drainage tube rarely comes out. If by chance the flow is interrupted, it soon is restored, the Dakin solution having broken up the fibrinous masses which obstructed it.

When the temperature has completely fallen to normal and no longer rises again, a condition which, when the treatment has been early instituted, may in general be secured by the fourth day, when the general state is clearly improved and one can see a radical change for the better from day to day, finally, when the laboratory examinations permit it, the two tubes are taken away and the total closure of the wound is made by sutures, which involve the entire thickness of the wall and pass as near as possible to the pleural edges. Precaution should be taken to withdraw the two tubes and to put the sutures in place while the patient is in a condition of forced inspiration, nose and mouth closed, so that the lung being brought up to the thorax wall may limit as much as possible the pneumo-thorax of the disinfected cavity. The day after the closure a spirometer is given to the patient, who begins to make respiratory gymnastics, with the object on one side to dilate the lung and on the other to prevent adhesions to the wall of the thorax

Although the authors never sought the primary extraction of the projectile in these infected pleuræ, nevertheless in five cases they were forced to undertake it. The projectile had been previously seen and localized by the X-ray, and they were led to it through a focus of rib fracture, or through a retroparietal abscess opening at its depth in the pulmonary cavity where the missile was found, either as it had been quite easily felt or in the midst of adhesions or false membranes. In two cases the projectile was found in contact with the wounded pleura

In searching for these foreign bodies they were greatly helped by the spreader of Tuffier In five cases the projectile was removed in the course of the thoracotomy for the pleural suppuration. In four cases they made removals of splinters or resection of the ribs. In thirteen cases they had to do with wounds produced by shell fragments. In all, fifteen cases are detailed, with one death, the patient dying from double pneumonia on the second day after infection.

The analysis of these cases demonstrated that the method of early closing of thoracotomy wounds in cases of purulent pleurisy does not involve danger for the patient. Should the temperature again rise from retained infected material after the closure, it would suffice to make exploratory punctures, and, if they were positive in the result, to open the operative wound, to drain anew and to replace the disinfecting tubes

The results obtained by this method were excellent. Upon an average, at the end of three weeks examination showed the thoracic wall not sunken in, lung mobile and painless, without signs of pleurisy and with normal breathing over the whole lung. The wound of the patients thus treated was closed at the end of fourteen days and healed permanently. Others were subjected to disinfection during periods varying from fifteen to sixteen days. Many of their colleagues had applied the same technic, with the same results.

#### TOTAL PLEURECTOMY FOR PACHYPLEURITIS

(Quatre nouveaux cas de pleurectonne totale pour infection pleurale avec pachypleurite) Dr J L Roux-Berger reports four cases of pleurectomy with decortication
of the lung done for the pachy-pleuritis due to pleural infections consecutive to wounds
of the lung from shell fragments. In these four cases the infection evidently had as
its cause incompleteness of the original operation. The orifice of entrance of the
fractured rib had been correctly treated in the primary operation, but the shell fragment
within or near the pleura had been left behind

As to the technic of the pleurectomy, the difficulty consists, once the lung has been released, to assure a sufficient drainage of the pleura without such drainage being too prolonged so as to prevent a new retraction of the lung and the formation of a new sac immobilizing it

The operative consequences were of the most simple character. The most rapid cure was obtained in a patient in which a very extensive pneumopexy was done, fixing to the parietes almost the entire lower border of the lung, and thus preventing secondary retraction. The author purposes, if he should have to treat another similar case, to attempt by extensive pneumopexy to fasten to the parietes a very large surface of the lung tissue. As far as the distensibility of the lung will permit it, such a manner of treatment will insure all the advantages of drainage without its inconvenience

Of the four cases subjected to operation, three were discharged cured, that is to say, they were completely healed, but it is not claimed that this anatomical cure corresponds to a physiological cure. In the fourth case a small pleural fistula remained

Lungs immobilized for so long a time within a rigid case in contact with a suppurating cavity fixed to the thoracic wall by adhesions, can only regain a very mediocre functional ability

All the patients came under treatment in very bad condition with suppurating fistulæ, in two of them bronchial fistulæ were present. In two of the patients the operation was divided into two steps, with intervening periods of from three to six weeks. In the first intervention a large costal resection was done, with excision of the fistula, removal of the projectile, the cutting away of the thickened part of the parietal pleura, the careful closing of the whole pleural cavity, with regular drainage and irrigations after the method of Dakin until the cavity had become sterilized. At the second intervention, after the removal of the newly formed osteo-fibrinous tissue, the lung was decorticated by excision as completely as possible of the thick fibrinous cover which bound it down. The inflated lung was then fixed to the chest wall by various points of suture. The wound in the chest wall was then sutured, with a drain in place.

The author advocates in similar cases as extensive a pneumopexy as possible. The broader the fixation the better the result

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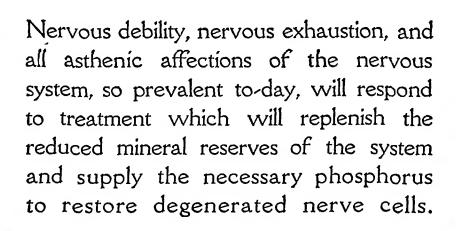
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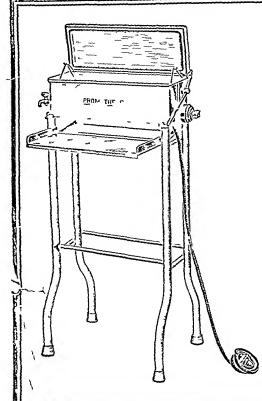
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